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BROOM FLAT RIDGE, SAN BERNARDINO COUNTY

CANDIDATE RESEARCH NATURAL AREA
Big Bear Ranger District
San Bernardino National Forest
United States Forest Service

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This document describing Broom Flat Ridge was prepared as a companion piece to two other candidate RNA reports: Horse Meadow RNA Establishment Report and Fisherman's Camp RNA Establishment Report. The portions of this report which deal with general information about the San Bernardino Mountain region are shared in part or in full with these reports. They are filed as separate reports in order that each candidate RNA site may be considered individually.

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I. INTRODUCTION

SITE DESCRIPTION

The Broom Flat candidate Research Natural Area covers approximately 468 acres (187 ha) northeast of Onyx Peak, San Bernardino County. Broom Flat Ridge includes the crest and flanks of a northwest-southeast trending ridge and supports more or less homogeneous stands of single-leaved pinyon (*Pinus monophylla*), western juniper (*Juniperus occidentalis*), and curlleaf mountain mohagany (*Cercocarpus ledifolius*). Both the pinyon and mountain mohagany reach unusually large sizes here. At the southeastern boundary of the proposed RNA, species characteristic of the southern mixed conifer forest (*Abies concolor*, *Pinus jeffreyi*) and some riparian and meadow species (*Salix* spp., *Smilacina stellata*) occur along a spring-fed creek. Although low in habitat diversity, this site does show good representation of all age classes of the dominant cover type as well as including a stand of *Arctostaphylos patula* along the ridge top where a fire apparently burned a portion of the site. High desert species such as *Purshia glandulosa* and *Artemisia tridentata*, characteristic of habitats just east of the ridge, intermix at this site, increasing the overall species diversity. A sensitive plant, Munz's hedgehog cactus (*Echinocereus engelmannii* var. *munzii*), has been reported on this ridge but was not seen during this survey. Two other sensitive plants occur here: *Astragalus leucolobis* and *Castilleja montigena.* An unusual and remarkable disjunct stand of quaking aspen, *Populus tremuloides*, is found at the north end of the site and is one of only two known occurrences of this plant in the San Bernardino Mountains.

PHYSICAL DESCRIPTION

Broom Flat Ridge is approximately 10 miles (16 km) south of Big Bear City in San Bernardino County, California (See Map 1: Vicinity Map; Map 2: US Forest Service Vicinity Map). Broom Flat Ridge may be reached by travelling State Highway 38 from either Big Bear City to the north or from Mill Creek/Redlands to the southeast. From Highway 38, a low standard gravel road, Road 2N01, allows access to the southern and eastern boundaries of the proposed RNA. This road is well maintained near Highway 38, as well as in the sandy soils east of Broom Flat Ridge. A spur road leaves from Broom Flat to the eastern base of the ridge. The north end of the Broom Flat Ridge is accessible only to four-wheel drive vehicles via Road 2N04 or to hikers. Access to the proposed Broom Flat Ridge is easy: the southwestern slopes of the ridge are accessible from the Pacific Coast Trail which crosses Road 2N01 less than 1/2 mile from Highway 38; the ridgetop is accessible from a pullout near Point 8095 on the Onyx Peak topographic quadrangle (T2N R2E Section 36); the northeastern slopes can reached from the Broom Flat spur road (T2N R2E Section 25). Within the site boundaries, travel is easy as the understory is generally open. As is customary in backcountry travel, water must be carried.

ADMINISTRATIVE LOCATION

The proposed Broom Flat Ridge Research Natural Area includes portions of Sections 25, 26, 35 and 36 in Township 2 North, Range 2 East, just west and south of Broom Flat, a locally prominent feature in the northwest quadrat of the Onyx Peak topographic quadrangle. Broom Flat Ridge lies wholly within the Big Bear District of the San Bernardino National Forest. District offices are in the city of Big Bear Lake, California; Forest Headquarters are in San Bernardino, California. The study area is covered by the ONYX PEAK, CALIF. U.S.G.S. topographic map (1:24,000; 7.5 minute, 1990). See Map 3: Topographic Map. As the site is on the extreme western edge of the Onyx Peak topo, it is advised that field workers carry the adjacent topographic quad (MOONRIDGE, CALIF.) as well.

JUSTIFICATION

In the transmontane regions of California, east of the main crests of the Cascade-Sierra axis and in the rainshadow of the peaks of southern California mountains, pinyon and juniper woodlands occur on the foothills, low mountains, plateaus and mesas of the arid west. Occupying over 47 million acres in the western United States, pinyon-juniper woodlands in

California represent the westernmost extent of a widespread vegetation type occurring in the Great Basin and Colorado Plateau regions. In the Great Basin, geographic distribution of juniper and pinyon largely overlap and, in recent years, both applied and basic research has focused on the pinyon-juniper woodlands. In California, however, pinyon and juniper occupy relatively distinct ecological niches throughout their ranges, with juniper woodlands dominating the lower, more gentle slopes and pinyon woodland typical on steeper, higher slopes. At Broom Flat Ridge, as at some other mid-elevation sites in southeastern California, the two woodlands overlap to form a habitat strongly reminiscent of the typical Great Basin pinyon-juniper woodlands.

In 1969 and 1974, the vegetation of the San Bernardino Mountains was mapped on eighteen 1:24,000 and 1:62,500 USGS topographic maps (Minnick, 1969 and 1974). Working from infrared aerial photographs (using Kodak Ektachrome Infrared Aero (CIR) Types 8443 and 2443), a highly generalized vegetation map of the San Bernardino Mountains was produced. This general vegetation map clearly shows overall trends and relationships between vegetation types, especially the horizontal banding of plant communities in response to elevational change (Map 4: General Vegetation Map of the San Bernardino Mountains). The following description of the pinyon pine vegetation of the San Bernardino Mountains follows Minnick (1969) closely.

In the San Bernardino Mountains, desert facing slopes between 4500-8000 feet (1370-2450 m) support extensive stands of *Pinus monophylla*. Pinyon pine is the dominant species throughout its range, but the vegetation type shows considerable diversity as associated species and co-dominants change in response to changing environmental factors (Map 5: Pinyon Vegetation Types in the San Bernardino Mountains).

Near the Mohave and Colorado Deserts at the eastern margins of the San Bernardino Mountains, pinyon woodlands are sparse. Here, and at the east end of Big Bear Basin, *Pinus monophylla* is associated with populations of Great Basin Sage scrub. Local climate conditions mimic those of the Great Basin-- with warm summer days and chilly nights-- and the plant communities resemble the typical basin vegetation of Utah or Nevada. Typical associates include *Artemisia tridentata*, *Chrysothamnus nauseosus*, and *Purshia glandulosa* as understory plants in an open pinyon woodland. In the San Bernardino Mountains, these associated plants range outside the woodland and occur as dominants in a scrub vegetation that covers the arid interior valleys and adjacent slopes.

At high elevations, in the rainshadow of San Gorgonio, pinyon is associated with three species common to the Western Coniferous Forest: *Cercocarpus ledifolius*, *Juniperus occidentalis*, and *Pinus jeffreyi*. *Cercocarpus ledifolius*, often attaining the size of a small tree in these mountains, commonly occurs along the arid margins of the western coniferous forest along with *Pinus jeffreyi*, and is a good indicator of the presence of mountain juniper. Jeffrey pine often occurs in desert drainages on the eastern slopes of the San Bernardino mountains as well. As illustrated in Map 5 (Minnick 1976), this pinyon-juniper-mountain mohagany type is relatively uncommon in the San Bernardino Mountains.

In California, northern juniper woodland occurs in two phases: as a western juniper woodland (*Juniperus occidentalis* var. *occidentalis*) in the open rolling country of northeastern California and as a mountain juniper woodland (*Juniperus occidentalis* var. *australis*) on ridges and mountain slopes in the Sierra Nevada and in the Transverse Ranges of southern California (Vasek and Thorne, 1988). Towards the desert, the mountain juniper woodland merges with *Pinus monophylla* to form a mountain juniper-pinyon woodland. Collectively, these pinyon-juniper woodlands occur along the transmontane slopes of the Sierra Nevada south of Alpine County, and through the Transverse and Peninsular mountain ranges to northern Baja California.

The large stands of mountain juniper, *Juniperus occidentalis* var. *australis*, that occur in the San Bernardino Mountains are the only large stands in southern California. At Broom Flat Ridge and to the south, at Onyx Summit, massive individuals of mountain juniper occur. Mountain junipers with trunk diameters of 6 feet (nearly 2 m) have been recorded and may be the oldest trees in southern California (Minnick 1976). In Modoc County, felled western junipers (the closely related *Juniperus occidentalis* var. *occidentalis*) attained ages of 450-500 years, based on growth ring estimates. The oldest and largest junipers generally occur on rock ridges or on flats of extensive rock slabs. Long-term survival of these trees at these difficult sites may be due to the protection this habitat provides from fire or from the greater availability of soil water supply on rocky outcrops (Eckert 1957; Vasek and Thorne 1988).

Both pinyon pine and mountain juniper are extremely long-lived trees. In the Great Basin, dominant pinyons are often 400 years old and have been known to reach 800 to 1000 years of age. In *Pinus edulis* research plots monitored over a 50 year period in New Mexico, pinyon trees added just 1.1 inch (2.8 cm) in height per year and average dbh increased only 1 inch (2.5 cm) in nearly 17 years (Little 1987).

Broom Flat Ridge was proposed as a candidate Research Natural Area to represent the pinyon target element. As noted above, pinyon occurs in the San Bernardino Mountains in a number of distinct phases. At Broom Flat Ridge, mostly open stands of pinyon-juniper woodland, primarily dominated by single-leaved pinyon, *Pinus monophylla*, cover the ridge. Herbaceous vegetation is scarce, with annuals and herbaceous perennials widely scattered throughout the woodland. Along ephemeral streams and permanent springs and seeps, especially along the west side of the proposed RNA, small wet meadows occur and support dense herbaceous vegetation. Notably large specimens of single-leaved pinyon, mountain juniper and curlleaf mountain mohagany add great interest to this site, as does the Great Basin aspect of the understory. With a vegetation associated with large western junipers typical of Modoc County in the far northeast of California, Broom Flat Ridge is unique to southern California. *Pinus monophylla, Cercocarpus ledifolius* and *Juniperus occidentalis* are all present in a wide range of age classes and are widely distributed on the site. Three sensitive plant species occur within the proposed RNA boundaries: Munz's hedgehog cactus (*Echinocereum engelmannii* var. *munzii*), Hecker's Indian Paintbrush (*Castilleja montigena*), and white-lobed locoweed (*Astragalus leucolobis*). A rare plant community of the San Bernardino Mountains--a stand of quaking aspen (*Populus tremuloides*)-- occurs in a dry tributary of Arrastre Creek within the candidate Research Natural Area.

II. PHYSICAL FEATURES

GEOGRAPHY

Along with the San Gabriel Mountains to the west, the San Bernardino Mountains are included within the Transverse Range geomorphic province of California. Running eastward from Santa Barbara to the Mohave-Colorodo deserts, the Transverse Range is an important transition zone between the floristic elements of northern and southern California (Hanes 1975). The northern portion of the range rises gradually from the valley floor on the west at 5000 ft. (1500 m) to form a gentle, undulating crest area that gradually increases in elevation to 7850 ft. (2400 m) north of Big Bear Lake. This area of relatively low relief and gentle hills and deep soils is an old-age surface, dating back to the early Quarternary. From Big Bear Lake, the crest of the San Bernardinos veers southeast to the highest portion of the range where the Santa Ana River and Mill Creek drain two prominent ridges on the main mountain plateau (Minnick 1988). Here the San Bernardino Mountains reach their highest elevation on the prominent San Gorgonio Mountain at 11,502 ft (3500 m).

Broom Flat Ridge candidate Research Natural Area is east of these prominent ridges that form the main crest of the mountain range. Lying in the rainshadow of San Gorgonio and Sugarloaf Mountain, Broom Flat Ridge is a high elevation, semi-arid site that shows a characteristic desert influence. Elevations within the candidate Research Natural Area range from 7100 ft. to 8095 ft. (2165 m to 2468 m). Slopes vary from 0° along the ridgetop to 43° along the steep terrain of the west- and east-facing slopes.

Several intermittent streams drain Broom Flat Ridge along both the east and west slopes. Arrastre Creek runs along the western boundary of the proposed Research Natural Area. Deer Springs, a year round spring except in severe drought conditions, occurs just outside the western boundary of the site and feeds into Arrastre Creek at the Deer Springs Trail Camp on the Pacific Coast Trail.

CLIMATE

As in most of California, vegetation in the San Bernardino Mountains is influenced primarily by the infrequent winter rains and prolonged summer drought typical of a dry Mediterranean climate. Within the mountains, the varied terrain and elevation produce a wide range of local climatic conditions. As winter storms move into southern California, moist southern winds travel in advance of incoming cold fronts. As this moisture-laden air moves up the slopes of the San Bernardino Mountains, precipitation increases from 15" (38 cm) annual precipitation in San Bernardino at the western edge of the mountains to 40" (100 cm) annual precipitation at the crest of the range. In the lee of the San Bernardino Mountains, a pronounced rainshadow effect occurs and precipitation decreases to less than 8" (20 cm) annually on the low elevation slopes bordering the Colorado and Mohave Deserts. During the dry season (April to November), storm activity nearly ceases except for occasional afternoon thunderstorms in July and August over the San Gorgonio crest region and in Big Bear Basin.

Much of the precipitation that occurs in the mountains falls as winter snows that accumulate in the mid- and high elevation coniferous forests. Here, a heavy snowpack ensures that soil moisture replenishment is delayed until the late spring melt frees the water at the beginning of the early summer growing season (Minnick 1988).

Broom Flat Ridge is east of the main crest of the range and the rainshadow effect is apparent. The nearest weather station to Broom Flat is at Big Bear Lake (34°15'N, 116°53'W) at 6790 ft (2070 m). Based on records from 1941-1970, the average precipitation at Big Bear Lake is 34.71" (88 cm) yearly. In 1990, the fourth year of a drought in California, annual precipitation was only 13.35" (34 cm). Winters and summer temperatures in this region of the San Bernardino Mountains are comparatively mild for a mountain environment: average temperatures range from 30° to 65°F (-1° to 18°C), with extremes ranging from a winter low of -7°F (-22°C) to a summer high temperature of 87°F (31°C). High elevations and cool temperatures result in a short growing season between mid-June and mid-September of about 100 frost free days per year.

GEOLOGY

Roughly 75 miles (120 km) east of Los Angeles, the San Bernardino Mountains are the highest and most rugged mountains of southern California. This very young mountain range consists of three primarily granitic blocks of Mesozoic age that have been uplifted along the San Andreas Fault on the south and along a complex network of thrust faults on the north. The last major period of mountain building occurred during the mid-Pleistocene (300,000-500,000 years ago) and caused the major uplift and westward tilting of the mountain blocks.

The San Andreas fault splits the main part of the range into two structural blocks which differ from one another by both origin and basement terrane material. The north block is eroded from an elevated mass of granitic basement rock that is part of the granitic batholith of the Mojave Desert. Geologically, it is considered part of the Mojave crustal block and, before uplift, was part of the Mojave Desert during Tertiary and early Quarternary time. Separated from the north block by the San Andreas fault system, the south block is primarily eroded from a gneiss and is similar to the rocks of the San Gabriel Mountains to the west, but unlike the rocks of the north block. The south block is divided into two slices by a diagonal branch of the San Andreas fault: the northeast slice is mountainous and contains Cenozoic sedimentary strata, while the southwest slice has low relief and no Cenozoic strata (Dibblee 1976).

Broom Flat Ridge is located on the north block of the San Bernardino Mountains. When the north block was elevated in the late Quarternary, its old erosion surface became a high plateau. Thus, the region around Broom Flat Ridge has relatively low to moderate relief for a mountainous area. In contrast, the southwestern portion of the north block, in the Mount San Gorgonio area, has been uplifted as several north-tilted blocks. This young upland area was rapidly uplifted and its old eroded surface is being quickly dissected into steep and rugged canyons.

Most of Broom Flat Ridge is composed of undifferentiated gneissic rocks which evidence suggests to be of Precambrian age (Map 6: Geologic Map). Dibblee (1976) notes that these banded or laminated gneissic rocks were recrystallized during Precambrian metamorphism mainly from sedimentary, or in part from granitic rocks, of Precambrian age. The quartz diorite to quartz monzonite mapped on Broom Flat Ridge is a medium- to dark-gray medium grained gneiss composed of quartz, plagioclase (andesine), potassic feldspar, biotite, hornblende, muscovite, and iron oxides in general order of decreasing abundance.

Other geologic materials occupy small portions of Broom Flat Ridge within the boundaries of the proposed Research Natural Area. In the general area along the ridgetop which is dominated by *Arctostaphylos patula*, a small area of Saragossa Quartzite (quartzite) occurs. This metasedimentary rock is of Paleozoic age and is described by Dibble as a gray-white to tan, very hard but brittle, fine-grained quartzite composed mainly of quartz and a little muscovite, biotite, and alkali feldspar. Brown iron oxide stains are common on fractures. Near the base of the east side of the ridge, in the direction of Broom Flat, stream channels are filled with unconsolidated alluvial fill of very late Pleistocene and Recent age. This surfical rubble occurs mostly as a gravel of unsorted boulders, cobbles, pebbles, or a pebbly sand. Finally, near the road (Road 2N01) that is used to access the southern end of Broom Flat Ridge (and almost outside the southern boundary of the proposed RNA site), a small area of intrusive plutonic rocks of Mesozoic age occurs.

SOILS

Detailed soil inventories of the Broom Flat Ridge Area are not available. Although the USDA Soil Conservation Service has completed detailed maps of the southwestern part of San Bernardino County (Woodruff and Brock 1980), the San Bernardino National Forest lands form the northern and eastern boundaries of the survey and are unmapped. However, the US Forest Service has released a draft version of an Order 3 Soil Resource Inventory (SRI) for the San Bernardino National Forest (Retelas 1980). This reconnaisance inventory was compiled to provide forest-wide information. Because most soil types were mapped by photo-interpretation and little ground-truthing was included in the inventory process, the resolution of the mapping was very low (that is, the minimum mapping area is about 100 acres or 40 ha). This SRI is not suitable for site-specific planning for Broom Flat Ridge. Nonetheless, this inventory is the

best information available at this time and is included here to aid subsequent researchers (Map 7: Soil Map).

The proposed Broom Flat Ridge Research Natural Area is mapped as a single soil type, the Olete-Goulding families association, which varies between the two mapping units only by the steepness of the slope on which the soil type occurs (FaE, 15-30 percent slope; FaF, 30-50 percent slope). The Olete-Goulding mapping unit is described as having the following two components in the poportions indicated: the Olete family (50%) and the Goulding family (25%).

The soils of the Olete family are moderately deep, well-drained and formed from material weathered from metamorphic rocks. Found in areas of both low relief and mountainous uplands, the Olete family of soils generally occurs on north to east aspects, but in steep areas, on the footslopes of all aspects. The surface soil is a dark brown, very cobbly fine sand loam, 0" to 3" (0-8 cm) deep, with a pH of 7.3. The subsoil varies from 3" to 26" (8-66 cm) and is a yellowish brown, very cobbly loam with a subangular block structure. It has a pH of 7.0. A substratum of highly fractured metamorphic rock generally occurs at about 26" (66 cm). It has an effective rooting depth of 20-40" (50-100 cm).

The soils of the Goulding family are shallow, well-drained and, as with the Olete family, formed from material weathered from metamorphic rocks. A typical soil type of the pinyon-juniper woodland, this soil generally occurs on south to west aspects, but on upper steeper slopes, may occur on all aspects. The surface soil is a brown gravelly sandy loam with a weak grandular stucture, 0" to 3" (0-8 cm) deep (pH 7.0). The subsoil is a yellowish brown very gravelly loam with a pH of 6.5. The metamorphic substratum is usually at about 12" (30 cm). It has an effective rooting depth of 10-20" (25-50 cm).

Small areas of a deep, well drained alluvial soil, the Morical and Hecker families complex, may occur inside the proposed eastern boundary near Arrastre Creek along the Pacific Coast Trail. A large area of this soil type (BoE) is mapped adjacent to and just east of Broom Flat Ridge. This complex occurs on alluvial fans or terraces with moderate relief (15 to 30 percent slope). These soils are brown gravelly loams with a granular, or fine granular, structure. The surface soils are 0" to 6" (0-15 cm), but the subsoils are very deep, ranging from 6" to 60" (15-150 cm), and have weathered from granitic or metamorphic rocks. The effective rooting depth is 40" (100 cm).

III. BIOLOGY

THE VEGETATION OF BROOM FLAT RIDGE

In 1975, Cheatham and Haller described a system of "natural communities" of California's landscape; this system has been revised several times by the California Natural Diversity Data Base. More recently, Holland (1986), working together with biologists knowledgeable about particular areas and community types, prepared a preliminary draft of the terrestrial natural communities of California. This listing of plant community types not only names the community, but describes the components of the vegetation, including characteristic species, site factors and geographic range.

Following Holland (1986), Broom Flat Ridge candidate RNA contains several community types (Map 8: Vegetation Map of Broom Flat Ridge). The site is predominately a Great Basin Pinyon-Juniper Woodland (Element Code 72121) with an understory of Great Basin Mixed Scrub (Element Code 35100), which also occurs in pure stands in scattered locations. A burned area of the woodland along the ridgetop has been replaced by Montane Mazanita Chaparral (Element Code 37520). Plants typical of the Jeffrey Pine Forest (Element Code 85100) occur along the Pacific Coast Trail that follows the creek at the western boundary of Broom Flat Ridge. This community can also be found at the eastern margin of the site and in some of the canyons and swales that act as cold air drainages. At the far north-western end of the side, and in areas along Arraste Creek, Southern Willow Scrub (63320) occurs in relatively small patches in particularly mesic sites. A rare habitat for this mountain range, the zonal Aspen Forest (Element Code 81800), occurs along a dry tributary of Arrastre Creek. Each vegetation type is described in turn below. A summary of the extent of each vegetation type is included in Table 1, which follows this section.

GREAT BASIN PINYON JUNIPER WOODLAND (Element Code 72121).

Pinyon-juniper woodland, sharing dominance here with curlleaf mohagany (*Cercocarpus ledifolius*), is the most extensive vegetation type at Broom Flat Ridge. Depending upon the slope and exposure at particular sites, this woodland shows significant variability in percent tree cover, relative proportion of the dominant tree species (pinyon and juniper), and understory components. However, because of the variety of slope and exposure along this north-south tending ridge, these site factors can vary tremendously within a very small area. As a result, the pinyon-juniper woodland here forms are a rather "homogeneous mosaic", where the overall aspect of the ridge is similar, but where you pass quickly through many variants of the overall vegetation type. Within a short distance, you can move from an open pinyon woodland with an almost bare understory of scattered perennial grasses, through a denser pinyon-juniper-curlleaf mohagany stand, and then into an open site with scattered trees of pinyon and juniper with an understory of Great Basin shrubs. Mapping these variants as individual units would produce a high-resolution, but not particularly meaningful, map and, in any case, is beyond the scope of this report. However, subsequent field work might emphasize the measurement of the site factors that cause this variation in the percent cover and associated species. Although discussed individually below, the variants of this pinyon-juniper woodland, are mapped as a single unit (Map 8).

As can be noted on Minnick's 1976 general map of the vegetation of the San Bernardino Mountains (included in this report as Map 4), the pinyon-juniper-curlleaf mohagany community type is a rather uncommon pinyon woodland type in the San Bernardino Mountains. On the steeper and drier slopes of Broom Flat Ridge, tree cover (including *Cercocarpus* within the arboreal layer, which grows here to more than 3 m) varies between about 25-45% cover. The slopes are dry, with up to 50% bare ground and rock. Downed wood typically covers about 5% of the ground surface. On these slopes, *Cercocarpus ledifolius*, some multitrunked and extremely large, shares dominance with *Pinus monopylla. Juniperus occidentalis* and *Pinus jeffreyi* occur on these slopes either as scattered individuals or may account for up to 10% of the tree cover together. Further upslope, as the site generally becomes drier, the jeffrey pine drops out, and the pinyon-juniper tree cover increases. In this often open woodland, species typical of the Great Basin occur as shrubby associates. *Artemisia tridentata, Chrysothamnus nauseosus, C. parryi, C viscidiflorus,* and *Purshia glandulosa*, together with the grass *Sitanion hystrix*, can account for 5-30% cover. Other associated herbs and

grasses occur in scattered locations, generally surrounded by bare ground, and account for very little cover. They include: *Bromus tectorum*, *Erigeron breweri* var. *breweri*, *Eriogonum davidsonii*, *Eriogonum wrightii* ssp. *subscaposum*, *Eriophyllum confertiflorum*, *Euphorbia palmeri*, *Galium angustifolium* ssp. *gabrielense*, *Gilia diegensis*, *Leptodactylon pungens* ssp. *hallii*, and *Stipa coronata*.

On the relatively flat and broad ridgetop at the south end of Broom Flat Ridge, the *Pinus monophylla* and *Juniperus occidentalis* woodland can be quite dense, with between 40-60% tree cover in places. A needle duff about 0.5-3" (1-8 cm) deep occurs in such places, together with decomposing pine cones throughout. Both the shrub and herb layer are relatively sparse (1-5%) in these dense woodlands and travel is easy. Tall specimens of *Cercocarpus ledifolius* remain important associates, occurring sometimes in dense stands and other times as scattered individuals. An occassional *Pinus jeffreyi* occurs as well. *Quercus chrysolepis* occurs in a few locations along the ridge. The scattered shrubs in the open understory include *Arctostaphylos patula*, *Chrysothamnus viscidiflorus*, and *Artemisia tridentata*. The herbs include *Astragalus leucolobis*, together with *Caulanthus major*, *Chenopodium fremontii*, *Cordylanthus filifolius*, *Cryptantha pterocarya* var. *purpusii*, *Erigeron aphanactis*, *Eriodictyon angustifolium*, *Eriogonum parishii* , *Eriogonum umbellatum* ssp. *munzii*, *Eriogonum wrightii* ssp. *subscaposum*, *Eriophyllum confertiflorum*, *Galium angustifolium* ssp. *gabrielense*, *Hymenopappus filifolius* var. *lugens*, *Leptodactylon pungens* ssp. *hallii*, *Salvia pachyphylla*, and *Tetradymia canescens*. *Opuntia basilaris* var. *basilaris* occurs among the rocks throughout this woodland. Munz's hedgehog cactus (*Echinocereus engelmannii* var. *munzii*), a sensitive plant species, occurs within the pinyon-juniper woodland of this proposed Research Natural Area. Although not found during the surveys conducted by either myself or A. Sanders, this plant was reported and photographed "growing in a crevice site on the north side of a large boulder on the main ridgetop" in the Broom Flat Reconnaissance Report (4060) filed with the Forest Service by L.E. Horton in 1983.

Open areas in the woodland are characterized by a decomposed granitic substrate with clumps of *Stipa coronata* occurring together with *Eriogonum kennedyi*, *Eriophyllum confertiflorum*, *Sitanion hystrix* and *Opuntia basilaris* near rocks or boulders. *Bouteloua gracilis* is a common grass in such sites and occurs in low spreading patches. Sites in the pinyon-juniper woodland that have a grassy understory typically support relatively dense stands of *Poa fendleriana* or *Stipa coronata*. *Oryzopsis hymenoides*, *Sitanion hystrix*, and *Stipa comata* are other common grasses that are associated with this pinyon-juniper woodland.

As noted in the geology section, most of this pinyon-juniper woodland community occurs here on undifferentiated gneissic rocks. The soils of this pinyon-juniper woodland are soils in the Olete-Goulding families association of soils. These soils are shallow to moderately deep, but always well-drained, with the surface soils varying from 0" to 3" (0-8 cm) in depth.

GREAT BASIN MIXED SCRUB (ELEMENT CODE 35100)

As mentioned above, species typical of Great Basin Mixed Scrub occur at Broom Flat Ridge as an important understory of the pinyon-juniper woodland. On south-facing slopes or in more xeric sites (due to shallow soils, or other factors), the pinyon, juniper, and mountain mohagany tree cover decreases and these trees may drop out completely. In the absence of a tree layer, these species form patches of Great Basin Mixed Scrub. There are generally extensive areas of bare ground or rock cover (up to 50%) at these sites. This moderately tall and fairly open shrubland is dominated by *Artemisia tridentata* and various *Chrysothamnus* species, most notably *C. nauseosus*. Shrub cover varies from 35-50%, with frequent individuals of *Sitanion hystrix* contributing between 5 and 15% cover in places. *Stipa coronata*, *Bromus tectorum*, *Oryzopsis hymenoides*, *Leptodactylon pungens* and *Galium angustifolium* are typical associates in the sparse herbaceous layer.

This vegetation occurs in relatively small patches along Broom Flat Ridge. Most of these sites are smaller than the minimum mapping area and are not mapped separately. However, there is a relatively large area of Great Basin Mixed Scrub in the southeast corner of the proposed RNA. This area may be a colder site than most of the pinyon-juniper woodland, due to cold-air drainage from the ridgetop. Scattered jeffrey pines occur amid this Great Basin Scrub on north-facing slopes and near the valley floor in this area. Another extensive patch of Great Basin Mixed Scrub, with few pinyons or jeffrey pines in the overstory, occurs on a south-facing slope and is visible from a pullout on Highway 38.

As this vegetation intergrades through the pinyon-juniper woodland, it too occurs on well-drained gravelly soils. Great Basin Mixed Shrub is not reported by Holland as appearing in the interior mountains of southern California; instead Big Sagebrush Scrub (Element Code 35210) is recorded. However, the sagebrush-chrysothamnus scrub at Broom Flat Ridge has only five of the listed sixteen species for Big Sagebrush Scrub and, thus, seems a better fit in the Great Basin Mixed Scrub, which clearly dominates much of the valley and low hills around Broom Flat to the east.

MONTANE MAZANITA CHAPARRAL (ELEMENT CODE 37520)

Along the top of Broom Flat Ridge, near the center of the site, an extensive patch of *Arctostaphylos patula* occurs. This vegetation fits best into Holland's Montane Manzanita Chaparral, although it has only one of the characteristic species. This stand of dense, 2-5 m tall chaparral occurs here as a post-fire successional stage (Minnick, pers. comm.). The site is dominated by *Arctostaphylos patula* (with 70-80% cover), which occurs at Broom Flat Ridge near the edge of its range. It is interesting to note that this manzanita site appears to be underlain by a different rock type than the rest of the Broom Flat Ridge. In this general area, a small outcropping of Saragossa Quartzite, a metasedimentary rock of Paleozoic age, occurs. This rock type may control the boundaries of the successional stage in some way and this may be an interesting topic for further investigation.

Travel through this *Arctostaphylos* patch is surprisingly easy, as long as you are willing to travel between the shrubs on the open rocky patches of bare soil that make up about 25% of this site. These open areas support a sparse assemblage of plants, none of which has very significant cover. Associates included *Artemisia tridentata, Sitanion hystrix, Cordylanthus filifolius, Hymenopappus filifolius* var. *lugens, Cryptantha pterocarya* var. *purpusii, Tetradymia canescens, Bouteloua gracilis,* and *Eriogonum parishii.*

JEFFREY PINE FOREST (ELEMENT CODE 85100)

A narrow strip of a mesic, tall, open forest dominated by *Pinus jeffreyi* forms the western boundary of the proposed Broom Flat Ridge Research Natural Area. In this shady canyon, bissected by Arrastre Creek, fed in part by Deer Springs, the jeffrey pine forest supports a diverse assemblage of understory shrubs and herbs typically found in riparian sites in the southern California mountains. The Pacific Coast Trail meanders along the creekbed through this plant community, making access easy and travel pleasant. The tree layer, predominantly jeffrey pine, accounts for about 30-40% cover, and occassional specimens of *Abies concolor* (in colder, moister areas) and *Juniperus occidentalis* (in steeper, drier areas) occur in scattered locations. At the very southern tip of the site, where *Abies concolor* is more frequent and the forest takes on the character of a mixed conifer forest, the soils are mapped as a deep, well-drained alluvial soil (the Morical-Hecker families complex).

The shrub layer throughout this forest is quite diverse and changes abruptly in response to local environmental conditions, such as slope, aspect and soil moisture. Immediately along the creek, amidst rocky boulders and sandy soils, thickets of *Salix lasiolepis* occur. Scattered *Potentilla glandulosa* and *Carex senta* are found in the dense shady understory of the willows. This community, although mapped within the jeffrey pine forest, is really a distinct vegetation type, the Southern Willow Scrub (Element Code 63320), a dense, broadleaved, winter deciduous riparian thicket dominated by several *Salix* spp. As it occurs along the creekbed in a mosaic with the jeffrey pine forest, and sometimes with an overstory of *Pinus jeffreyi*, it is not treated separately here.

Away from the creek, but still on moist soils at relatively flat sites, the *Salix* spp. are joined by *Ceanothus cordulatus* and *Rosa californica.* The California wild rose often appears in bright green, 2 m tall thickets. *Artemisia tridentata* occurs in scattered locations throughout, especially at the dry upper edge of the forest, where it intergrades with the pinyon-juniper woodland.

The herbaceous layer in the forest has a meadowy aspect in some particularly mesic sites. Here, under an open tree layer (less than 25% cover) of *Pinus jeffreyi, Juniperus occidentalis* var. *australis*, and *Abies concolor*, bright green swales occur with nearly 100% cover of a diverse mix of tender herbaceous plants. *Smilacina stellata* and *Solidago californica* are the dominant species in the herbaceous layer, together accounting for at least

75% of the cover. Frequent associates include *Artemisia ludoviciana, Geranium richardsonii, Mimulus pilosus, Mimulus rubellus, Potentilla glandulosa, Stachys albens*, and *Taraxacum officinalis. Equisetum laevigatum, Carex senta*, and *Carex alma* occur in the wettest areas. These open meadowy sites are often ringed with a thicket of shrubs, including *Ceanothus cordulatus, Rosa californica, Symphoricarpus parishii*, and *Salix lasiolepis.* At the periphery of these meadowy sites, *Artemisia tridentata* ssp. *tridentata* and *Cercocarpus ledifolius* intergrade in the driest locations.

In the dappled shade of more heavily wooded and drier sites, among the jeffrey pines, the scattered boulders and the soft bare alluvial soil, a variety of herbaceous plants enliven the forest. Often fragrant or colorful, these herbaceous associates of the jeffrey pine forest are frequently widely scattered and include: *Amorpha californica, Aquilegia formosa* var. *pauciflora, Artemisia ludoviciana, Astragalus leucolobis, Bromus tectorum, Castilleja miniata, Chenopodium fremontii, Cryptantha* sp., *Cryptantha echinella, Draba corrugata, Erysimum capitatum, Monardella linoides* ssp. *stricta, Oenothera caespitosa* var. *marginata, Opuntia basilaris* var. *basilaris, Orobanche californica* ssp. *feudgeii, Penstemon grinnellii* ssp. *grinnellii, Potentilla wheeleri, Solidago californica*, and *Tetradymia canescens. Poa fendleriana, Sitanion hystrix*, and *Stipa comata* are typical grass associates, occurring either scattered in the forest understory or in small meadowy patches with other herbaceous plants. Shrubby associates of the jeffrey pine forest include *Arctostaphylos patula* ssp. *platyphylla, Purshia glandulosa, Ribes cereum, Rosa woodsii*, and *Symphoricarpus parishii.*

Jeffrey Pine Forest also occurs along the eastern margin of Broom Flat Ridge; *Pinus jeffreyi* often climbs the eastern canyons, but is here associated with species typical of Great Basin Mixed Scrub. A variant of the jeffrey pine forest is found in cold air drainage basins along the top of Broom Flat Ridge. In these gently sloping ridgetop depressions, jeffrey pine shares dominance with *Pinus monophylla* and *Cercocarpus ledifolius.* A single large specimen of *Quercus chrysolepis* was found near one of these areas. Perennial grasses, typically *Oryzopsis hymenoides*, dominate the open understory.

ASPEN FOREST (ELEMENT CODE 81800)

Near the very northern tip of the Broom Flat Ridge candidate Research Natural Area, an unusual disjunct grove of quaking aspen, *Populus tremuloides*, occurs. Although abundant east of the Sierran crest, especially between Lake Tahoe and Mono Lake, and then again to the south in the mountains of Baja California, Sierra San Pedro Martir, *Populus tremuloides* makes an unexpected jump over the mountains of southern California. In the San Bernardinos, quaking aspen is found in only two locations: along a tributary of Arrastre Creek here at Broom Flat Ridge (Map 8) and on Fish Creek, just northeast of the San Gorgonio Wilderness. These two groves, disjunct from the nearest populations by more than 200 miles to the Sierran aspens and 200 miles to the nearest Mexican aspens, are believed to be relicts from the late Pleistocene when the climate of southern California was much cooler and wetter. Although seemingly suitable habitat for this species occurs throughout the San Bernardinos, it is restricted for unknown reasons to these two groves.

Holland (1986) distinguishes this zonal Aspen Forest from the Aspen Riparian Forest (Element Code 61520) which typically occurs in the rich wet soils along slow-flowing streams and has an understory of species characteristic of montane meadows. In contrast, the zonal Aspen Forest can occur away from streambanks and the transition between the aspen grove and other plant communities can be abrupt. In addition to the distribution noted above, the zonal aspen forest occurs in scattered locations in the interior Klamath Ranges and Cascade Range, is common in the Warner Mountains, and scattered in the White Mountains near the Inyo-Mono County line. Holland also notes that *Populus tremuloides* regenerates from vegetative offshoots and entire groves may consist of single clones.

At Broom Flat Ridge, the quaking aspen grove occurs about 200 yards up a rocky, dry tributary amid a woodland typical of the upper limits of the jeffrey pine forest where it grades into the Broom Flat Ridge pinyon-juniper woodland. In 1989, Mr. William Jones, a geography student at California State University, Fullerton did a survey of this aspen grove (Jones 1989). The grove was mapped (Figure 1) and sampled using the point-centered quadrant method. Understory species were sampled along 20 profile transect belts.

This Arrastre Creek aspen grove, as it is commonly called, occurs in a steep canyon, approximately 500 ft. wide and 200 ft. deep. Jones reports:

> The canyon entrance is relatively narrow. Here, the flat to gently sloping bottom starts at a width of about 50 ft, while aspen grow up to about 10 ft on either side of the rather steep side slopes. From this point, the bottom width averages about 30-60 ft., then widens to just over 100 ft. maximum. Here the aspen grove is thickest (sic: *most dense? greatest extent?- Burke*). The bottom then narrows again through a nearly vertical, steep walled mini-gorge, about 15 ft. wide and 20-30 ft. high. At this point, the grove ends. Overall, slopes on both sides of the creek bed range from gentle to fairly steep (10-45°).

Populus tremuloides occurs here with 7 other tree species: *Pinus monophylla, Cercocarpus ledifolius, Pinus jeffreyi, Salix scouleriana,. Juniperus occidentalis* var. *australis, Pseudotsuga menziesii**, and *Salix lasiolepis*. Tree cover for all species combined was calculated to be about 50%. *Poa fendleriana* was the most widespread understory associate. Other associates include: *Artemisia dracunculus**, *A. ludoviciana, A. tridentata, Carex* sp., *Eriophyllum lanatum, Erysimum capitatum, Galium* sp., *Leptodactylon pungens, Opuntia basilaris, Penstemon eatonii**, *Purshia glandulosa, Salvia pachyphylla,* and *Stipa* sp. *Brickellia californica**, *Chrysothamnus nauseosus,* and *Echinocereus triglochidiatus* did not occur within a transect, but were recorded from the general area. Understory cover was estimated to be about 12%. The plants marked with an asterisk were not collected by either Sanders or during this past field season and, although most are likely present, they are not included on the plant lists until their presence is confirmed. *Pseudotsuga menziesii* is not reported in Munz (1974) as occurring in southern California.

The grove is estimated to cover 0.74 acres (0.30 ha) along 800 ft. on the north-facing slope of the unnamed Arrastre Creek tributary (Figure 1), at elevations ranging from 7160 to 7255 ft. (2184-2213 m.). US Forest Service personnel estimated the grove to contain about 300 aspen trees; Jones reports an estimate of 486 aspen trees over 5 ft. (1.5 m) in height, with 22 exceeding 40 ft. (12 m). Figures and tables summarizing density, frequency, and height and diameter classes (Figure 2) are available in Jones' unpublished report on file at the Big Bear District Headquarters (Neel, pers. comm.). Dr. Scott Zona, Rancho Santa Ana Botanic Garden, conducted an electrophoretic analysis (Zona 1989) of 5 populations of *Populus tremuloides*: the two San Bernardino Mountain populations, including the Arrastre Creek aspens, and three populations from the Sierra Nevada (Cook House Meadow, Luther Pass, and Taylor Creek). The genotypes of the San Bernardino Mountain populations were found to be identical, except for one subpopulation at Fish Creek. In contrast, each of the northern (Sierran) populations was composed of one or two clones, with distinct genotypes. The San Bernardino Mountain aspen populations were found to be genetically different from any of the northern clones.

VEGETATION SAMPLING AT BROOM FLAT RIDGE

In 1989, Dr. Andrew Sanders, along with an assistant, Jennifer Lyman, sampled the vegetation at Broom Flat Ridge. Three belt transects, each 100 m long and 5 m wide, were established on the site in areas where access was reasonable. Once a general area was selected for sampling, a randomly selected compass bearing was used to set the transect location. Each 500 m^2 transect was sampled with 10 subplots (10 m X 5 m) in order to measure the amount of variation in the vegetation at the sampling site.

The name of each species occurring within each subplot was recorded. In the herbaceous layer, all plants were simply recorded and counted. For woody species, such as trees and shrubs, the height was measured, as well as dbh (for tree species) and two diameter measurements of the crown. Crown cover is calculated by the "Crown-Diameter Method", using the formula $cc = (\text{Diameter 1} + \text{Diameter 2} / 4)^2$. The first diameter measure was taken at the longest axis of the crown; the second, at a right angle to the first measurement.

Cover is usually defined as the vertical projection of the crown to the ground surface and is generally expressed as a percent of the total sampling area. Cover is considered to have greater ecological significance than density, as it gives a better measure of plant biomass than does the number of individuals. Mueller-Dombois and Ellenberg (1974) emphasize the importance of plant biomass to community analysis when they note:

> Plant biomass has a major influence on the stand climate in terms of light and temperature relationships. It influences the water relations through rainfall interception and transpiration rate per unit area, and it is closely related to the

volume of circulating nutrients in the ecosystem. Moreover, the amount and characteristics of the plant biomass are of direct importance to the animals associated with the vegetation, because the plant biomass provides their shelter and food.

Computer analysis of the transects, calculating percent cover for the dominant species, was done by Tom Lyman, Scientific Programming Corporation, Idyllwild, California in June 1989. The results of this analysis are presented in Table 2. Approximate locations of transects are noted in Map 9.

Transect Descriptions

SITE 1. This is an open site, with less than 20% total cover. The dominant plant in the site is *Cercocarpus ledifolius*, associated with an occasional *Pinus monophylla* and scattered *Artemisia tridentata.* In addition to the mountain mohagany in the tree layer, *Juniperus occidentalis* and *Pinus jeffreyi* are also present in the transect, but do not have a significant cover value.

Along with the more frequent *Artemisia tridentata, Purshia glandulosa* and *Chrysothamnus nauseosus* are also present in the shrub layer. The understory seems to be predominantly grasses: *Poa fendleriana* (363 individuals), Sitanion hystrix (87), and some *Stipa coronata* (63). The herbaceous layer includes: *Eriogonum fasciculatum* (37), *Eriophyllum confertiflorum* (14), *Leptodactylon pungens* (13), *Eriogonum wrightii* (6), and individual specimens of *Arabis pulchra, Astragalus purshii,* and *Opuntia basilaris.*

SITE 2. This site is typical of the rather uncommon San Bernardino Mountain pinyon-juniper-curlleaf mountain mohagany woodland that this candidate RNA seeks to protect. Total plant cover is almost 50%, with *Juniperus occidentalis, Pinus monophylla* and *Cercocarpus ledifolius* all contributing a significant amount of cover to the tree layer. The shrub layer is largely absent, except for the *Cercocarpus* which occurs in both the shrub and tree strata at this transect. The herbaceous layer is primarily the grass *Poa fendleriana* (1385 individuals), but *Sitanion hystrix* (6), *Caulanthus major* (3), *Hesperocholoa kingii* (3), *Stipa coronata* (1), *Eriogonum fasciculatum* (1), and *Eriogonum microthecum* (1) are also present. This site shows evidence of fire.

SITE 3. This site is best described as an open pinyon pine woodland, where the *Pinus monophylla* contributes most of the cover, occassionally associated with *Juniperus occidentalis* and, infrequently, with *Cercocarpus ledifolius.* Total cover is only 35%. There is a well-developed shrub layer that includes *Purshia glandulosa*, *Artemisia tridentata*, and *Chrysothamnus nauseosus.* The herbaceous layer is nearly absent, with only a few *Poa fendleriana* (16 individuals), *Stipa coronata* (2), and *Galium parishii* (2). Burro sign was noted at this transect.

TABLE 1. Extent of the Vegetation Types of Broom Flat Ridge, San Bernardino County.

These acreage estimates are based on the Vegetation Map (Map 8) of Broom Flat Ridge. As noted in the text, several of the vegetation types intergrade with one another; Great Basin Mixed Scrub occurs as both an understory and in mosaic with the Pinyon-Juniper Woodland. No attempt was made to account for these inclusions of other types within the widespread typical vegetation type. The aspen grove is mapped as 3 acres to emphasize its location.

Great Basin Pinyon-Juniper Woodland	295 acres (118 ha)
Jeffrey Pine Forest	102 acres (41 ha)
Great Basin Mixed Scrub	58 acres (23 ha)
Montane Manzanita Chaparral (*Arctostaphylos patula* stand)	12 acres (5 ha)
Aspen Pine Forest (*Populus tremuloides* stand)	0.74 acres (0.30 ha)

TABLE 2. Summary Table of Sander's Broom Flat Ridge Transects, May 1989.

	Site 1 (SBA1)	**Site 2 (SBA2)**	**Site 3 (SBA3)**
LOCATION	west slope 1/4 from south end	east slope at north end	ridgetop above Site 2
OBSERVERS	Lyman and Sanders	Lyman and Sanders	Lyman and Sanders
DATE OF FIELD WORK	24 May 1989	24 May 1989	24 May 1989
PLOT SIZE	500 m sq.	500 m sq.	500 m sq.
TOTAL PLANT COVER	93.657 m sq.	234.028 m sq.	171.641 m sq.
PERCENT COVER	18.73%	46.80%	34.32%

The following information summarizes the percent cover information for the species which have the highest percent cover in the transects.

SPECIES NAME			
Pinus monophylla	3.54%	10.05%	27.83%
Juncus occidentalis	+	31.37	4.72
Cercocarpus ledifolius	13.79	5.37	1.06
Chrysothamnus nauseosus	0.17	-	+
Artemisia tridentata	0.92	-	0.11
Pinus jeffreyi	0.03	-	-
Purshia glandulosa	0.25	-	0.58
PERCENT COVER	18.73%	46.80%	34.32%

SENSITIVE PLANT SPECIES OF BROOM FLAT RIDGE

In the reconnaisance report of Broom Flat Ridge submitted to the USFS (Report #4060) in 1983 by L.E. Horton, Munz's hedgehog cactus (*Echinocereus engelmannii* var. *munzii*) was reported and photographed "growing in a crevice site on the north side of a large boulder on the main ridgetop." *Echinocereus engelmannii* var. *munzii* is listed as a Sensitive plant by the US Forest Service. The California Native Plant Society list of Rare and Endangered Vascular Plants of California (Smith and Berg 1988) includes this plant on List 4 and the California Natural Diversity Database records it as a G5S2.2 element. These rankings indicate that the plant is uncommon, but distribution is adequate and it is not likely that the plant is threatened with extinction in the near future. This species was not found by either A. Sanders in 1989 or during this survey (1991).

In 1990, Neel began a survey of the variation of the populations of *Echinocereus engelmannii* var. *munzii* in six populations occurring in four mountain ranges: two populations in the San Bernardino Mountains, one in the San Jacinto Mountains, two in the Laguna Mountains, and one in the Sierra de Juárez Mountains of Baja California. In a progress report, Neel (1990) reported a high density population (100-500 individuals per hectare) near Arrastre Creek at the south end of Lone Valley (Map 10), just north of Broom Flat Ridge Candidate RNA. Neel has reviewed a photocopy of the photograph submitted in Horton's report and confirms that it appears to be *E. e.* var. *munzii* (Neel, pers. comm.) Neel reports the typical sites where *Echinocereus engelmannii* var. *munzii* occurs within each mountain range:

> Observed sites range in elevation from 1060 and 2080 meters and are generally on south or west facing exposures. Soils are shallow, often high in clay content and are usually associated with metamorphic rocks. Co-occurring vegetation often includes low growing subshrubs and cushion plants. In the San Bernardino Mountains...scattered individuals are found in openings in pinyon woodland on south facing slopes.

Although this plant was not recorded during the last two field surveys, suitable sites do occur at Broom Flat Ridge and it is possible that further field work will locate this plant on Broom Flat Ridge.

Two other plants found at Broom Flat Ridge are listed as sensitive plants. The California Native Plant Society lists *Astragalus leucolobis* on List 1B: "Plants Rare, Threatened or Endangered in California and Elsewhere". This low-growing wooly locoweed is reported to be relatively common and not threatened within the San Bernardino Mountains (Neel, pers. comm.), but it is considered threatened and endangered in some parts of its range. The CNPS R-E-D code (Rare-Endangerment-Distribution) is 2-2-3; that is, occurrence is confined to several populations; the species is endangered in a portion of its range; and the species is endemic to California. At Broom Flat Ridge, *Astragalus leucolobis* was noted both at the pinyon-juniper woodland edge of the jeffrey pine forest, near the Pacific Coast Trail, and in rather large numbers in the clearing near the top of the ridge. This clearing shows evidence of parking, illegal firewood gathering, and camping (fire rings, tent sites). Further work should be timed to collect specimens to describe the extent of this species at this site.

The second sensitive plant, *Castilleja montigena* [syn. *C. martinii* var. *ewanii*], Heckard's Paintbrush, has been included by CNPS on List 4: Plants of Limited Distribution, the so-called "watch list". This plant was recorded by Sanders (1989) as "locally common perennial in open areas at edge". This recently described Indian Paintbrush (Heckard et al 1980) was not collected during this survey (1991).

Although not listed as a sensitive plant, the occurrence of a grove of *Populus tremuloides* must be noted as a "sensitive" or rare community type that adds significantly to the value of this site as a Research Natural Area.

FAUNA OF BROOM FLAT RIDGE

No detailed studies of the fauna of Broom Flat Ridge are available. Lists of amphibians, reptiles, birds and mammals that may occur on the site are available upon request from the Forest Wildlife Biologist at San Bernardino National Forest Headquarters. Using the Statewide Wildlife Habitat Relationship System (Timossi 1989), a database system originally programmed for Pacific Gas and Electric and now maintained by the State of California Department of Fish and Game, it is possible to "filter" the names of the wildlife that may occur at a particular site by carefully listing the physical and biological characteristics of the site. It is, however, essential that an experienced wildlife biologist review the list for obvious errors of inclusion or exclusion. I am grateful to Mr. Steve Loe for the list that appears as Appendix C: Predicted Wildlife Species of Broom Flat Ridge: A Preliminary Checklist. The list generated by the database based on the site characteristics I submitted was reviewed by Loe and many unlikely species were eliminated based on species information included in "California's Wildlife, Volumes 1-3" (Zeiner, et al 1988). The presence of these species should be verified by subsequent ground surveys.

A portion of Arrastre Creek runs along the western side of the candidate Research Natural Area. This area is likely to have abundant-riparian dependent wildlife, especially as it is in a transition zone between the mixed conifer forest and the pinyon-juniper woodland. The presence of the Pacific Coast Trail in this area makes it an attractive area for birdwatching by the general public. Dr. Bill LaHaye, a biologist surveying spotted owls in the San Bernardino Natural Forest, noted the territory of the spotted owl, a Forest Service Sensitive Species and a California "species of special concern" as occurring along the proposed southeastern boundary of the candidate RNA (Map 11). As Highway 38 and the Pacific Coast Trail both cross the spotted owl territory, it is unlikely that the establishment of an Research Natural Area will adversely affect the species; instead, the presence of these birds nearby enhances the value of establishing of an RNA in this area.

IV. LAND USE

PREHISTORIC LAND USE OF THE SAN BERNARDINO MOUNTAINS

The earliest known population to inhabit the San Bernardino Mountains were a native people who were given the name *Serrano*, or "mountaineer", by the Spainards. This tribal people are classified by ethnographers as members of the Southern California branch of the Shoshonians. In the mountains, the Serranos settled on a semi-permanent basis in large villages near reliable sources of water and within gathering range of the plants and wildlife that the people depended upon. Three Serrano village names are reported from the Big Bear area: Yuhaviat ("Pine Place"), Kayahpiat, and Achavat. Seasonal camps were also established and used by Serranos during the harvest times of their important plant foods, which included chia seeds, acorns, and pinyon nuts. Numerous grinding stations are reported from these satellite camps. There is some evidence that these mountain villages may have been occupied year round. In addition to these permanent villages, however, foothill clans are known to have visited the mountains seasonally, probably for hunting and pinyon and acorn harvest. (various sources cited in Robinson 1981).

The Serranos were hunters and gatherers and followed a seasonal cycle of harvest from springtime gathering of tubers and greens, summertime seed collection, and fall pinyon and acorn harvests. Although more than 200 plants were used for food and medicinal purposes, the primary plant foods for the Serrano were acorns, pinyon nuts, and seeds from chia, buckwheat and sage plants. Deer, mountain sheep, rabbits and other small mammals were hunted by the men of the villages and this meat supplemented the plant foods gathered by the women. Food-gathering trails, hunting trails and trading routes crisscrossed much of the San Bernardino Mountains, including the ancient Mohave trail, and allowed travel within the mountains as well as trade between desert Indians and the peoples of the mountains and coastal plains beyond.

In the western United States, the native Americans are known to have occupied pinyon-juniper woodlands for thousands of years. Archaeological digs near Las Vagas, Nevada date back 30,000 years (Wasson 1987). In the San Bernardinos, no such archaeological record exists. One archaeological site (Site Sbr-#4176) is identified as occurring within the Broom Flat Ridge proposed boundaries (Map 12). All that is noted about the recorded site, however, is the presence of a rock cairn and that "These seem to be sites of seasonal gathering camps, especially for pinyons" (Cultural Systems Research, Inc. 1981).

HISTORIC LAND USE OF THE SAN BERNARDINO MOUNTAINS

The first recorded European to have reached the San Bernardino Mountains was a Spanish soldier, Pedo Fages, who in 1772 pursued army deserters across the mountains and into the Colorado desert. In 1776, Fray Francisco Hermenegildo Garces crossed the San Bernardino Mountains from the lower Colorado River to Mission San Gabriel along the Mojave trail. By the 1820s, the Spainards and the Californios (i.e., Mexican Californians) were engaged in agriculture in the San Bernardino Valley to the south of the mountains. They built an irrigation ditch from Mill Creek to irrigate their lands, the earliest known use of water from the San Bernardino Mountains. Aside from some water use, and small-scale lumbering, the Spainards and Californios had little impact in the mountains.

The 1840s were the beginning of significant European impact in the San Bernardino Mountains. The Wilson expedition, in 1845, took a band of soldiers into the mountains in pursuit of cattle rustlers. The name of Bear Valley dates back to Wilson's description of the upland country (Robinson 1981; quoted from Woodward 1934).

> Before arriving at the lake we captured a village. The people of which had all left except two old women and some children. On the evening of the second day we arrived at the lake, the whole lake and swamp seemed alive with bear.
>
> The 22 young Californians went out in pairs and each pair lassoed one bear, and brought the result to the camp so that we had at one and the same time eleven bears.
>
> This prompted me to give the lake the name it now bears.

This expedition opened up a part of the range that was little known by Europeans settlers before. During these years, the mountains became known by the name they are called today: the San Bernardinos. In the late 1840's, Mormon settlers in the valley town of San Bernardino began lumbering in the mountains to provide for the town's building needs. Their lumbering went well up the shoulder of San Gorgonio Mountain.

Lumbering and sawmills remained an important early use of the San Bernardino Mountains long after the Mormons returned to Utah in 1857. However, soon gold became the magnet that lured people into the San Bernardino Mountains. A discovery of gold in 1860 in Holcomb Valley precipitated at gold rush that pulled hundreds of men into the mountains and initiated the building of roads, housing and stores.

Water next attracted the growing population of southern California into the mountains and, in 1884, a consortium of businessmen from Redlands built a dam in Big Bear Valley that created the present-day 8 mile long Big Bear Lake. Lake Arrowhead was built in much the same way, with investors from Ohio building a dam across Little Bear Creek in 1908.

In recent times, recreation has been the most important draw that pulls people into the San Bernardino Mountains. The first mountain resort as built at Big Bear Lake in the 1890's; by the 1920s, many resort communities were subdivided and built, including Lake Arrowhead, Crestline, Lake Gregory, and Running Springs, among others. Ski areas followed and the San Bernardino Mountains now receive about seven million visitors annually, making them one of the most heavily visited mountain regions in the United States.

Little information is available on the local history of the Broom Flat region. Prior to 1900, mining occurred at the Rose and Monte Cristo mines to the east of Broom Flat, while a sawmill operated at Broom Flat itself. North of Broom Flat Ridge, at Gocke Valley, a pioneer named Jim Erwin homesteaded land near Deadman's Lake. Camp Oakes, less than a mile from the site, still operates (Jones 1989, Leadabrand 1964, Vaughan 1922).

IMPLICATIONS OF RECENT AND CURRENT USE AT BROOM FLAT RIDGE

Although easily accessible by two US Forest Service roads (Road 2N01 and Road 2N04) and bordered on the western edge by the Pacific Coast Trail, the Broom Flat Ridge candidate RNA site is surprisingly free of disturbance. Hikers along the Pacific Coast Trail tend to stay quite near the trail; few are likely to climb a south-east facing pinyon-juniper exposure with an insignificant summit view. Deer Springs Trail Camp has only a local impact.

The most significant current disturbance is near the top of the ridge, near Road 2N01. In this relatively level open area, there is clear evidence of off-road parking, illegal firewood gathering, and some camping. A few fire rings can be found nearby and along the ridge to the north. The impact of the campsites appears confined to this region and to a couple of sites at the base on the ridge on the eastern boundary (at the end of the Broom Flat spur roads) of the candidate Research Natural Area. Camping is generally incompatible with Research Natural Areas as it encourages firewood gathering, soil compaction, clearing, littering and human waste pollution. As camping is difficult to stop once an area is known and has been used for some time, some alternate primitive sites might be provided nearby, but off the RNA site itself.

Most of the surrounding lands are owned by the US Forest Service, although there are a couple of private inholdings (Map 2: US Forest Service Vicinity Map). One, an old ranch site, is to the east of the ridge, near Broom Flat itself (T2N, R3E, less than 1/4 of Section 25); the other is south of Juniper Springs (T2N, R3E, south half of Section 31). Cattle grazing has been reported from around the Juniper Springs Group Camp. These cattle had apparently wandered south from a BLM allotment north of the Forest. These cattle could have wandered up into the pinyon woodland, but it is not likely that they caused significant damage. A high concentration of burros is reported in this general area and burro sign was observed on Broom Flat Ridge. Like the cattle, their main impact on the site would be some trampling and grazing.

FIRE HISTORY

Although requested from the supervisor's office, no fire history maps of this area were received. A review of historical photos of this area shows that the middle of Broom Flat Ridge was burned in approximately 1915. This information is not available in the fire history,

but was gleaned from oblique photos taken of the region in the 1920's. The 1915 fire either burned clean, or the burned pinyons were harvested. The east and west sides of the site appear to have been missed by this blaze. In 1970, there was a fire in Sections 25 and 26 to the east, but not on Broom Flat Ridge itself (Minnick, pers. comm).

Pinyon and juniper trees are easily killed by fire due to their small stature and the ease with which fires can spread from surface fuels (that is, the associated shrubby species in the pinyon woodland) that reach nearly or into the tree canopies (Minnick 1991). Prior to fire suppression in the San Bernardino Mountains, canopy fires occurred centuries apart. Among the conifer forests of these mountains, burns are most frequent among dense stands at the highest elevations and least frequent among open stands near the desert. Here, at the semiarid margin of the desert, surface fuel build-up is limited by the low precipitation. As the possibility of ignition from lightening strikes is virtually always present, fires in this vegetation type are fuel driven (Minnick, pers. comm.).

Pinyon-juniper woodland recover slowly from fire. Reestablishment begins with the resprouting of species characteristic of Great Basin Mixed Scrub. As the seed and cones of pinyon and juniper are destroyed along with the trees, seedling establishment is dependent upon long-distance dispersal of seeds by birds and small mammals. The woodland is reestablished very slowly for 10-20 years after a burn; saplings do not become conspicuous for 50 years. A pinyon-juniper woodland canopy can take as long as a century to develop (Minnick 1991). *Cercocarpus ledifolius* is a prominent associate at Broom Flat Ridge. This species does not stump sprout and takes 20-30 years to recover from a fire. The tremendous size of the pinyons, junipers, and curl-leaf mountain mohagany at Broom Flat Ridge suggests that most of this site has escaped burning for many centuries. An exception may be the *Arctostaphylos patula* site on the ridgetop, which is believed to be a fire scar.

V. RECOMMENDATIONS

RESEARCH NATURAL AREA BOUNDARIES

The boundaries on all the maps included in this report are essentially the same as those which accompanied the purchase order for this report. These boundaries form an area that is a coherent research unit, including the entire Broom Flat ridge and its watershed. As noted earlier in this report, this site provides excellent access along trails, roads and through relatively open terrain for researchers and their equipment. The boundary lines marked on the US Forest Service Map included in Horton's original reconnaissance report excluded the aspen grove, while the accompanying topographic map included the grove. This is due to a slight inaccuracy of the mapped location of the aspen grove on the US Forest Service Map (Map 2) and does not indicate any change in proposed boundary lines.

MANAGEMENT CONCERNS

Because this site attracts relatively little attention compared to other more scenic areas in this intensively used southern California mountain range, there are few serious management problems. As stated earlier, the existing prohibition of grazing and firewood gathering is necessary for a Research Natural Area and should be diligently enforced. Some relocation of primitive camp sites outside RNA boundaries may relieve the impact the site currently suffers along Road 2N01 at the ridgetop and on level sites at the eastern margin.

Some topics that merit further study have been mentioned above, including a closer examination of the genetic composition of the quaking aspen grove, rare plant surveys for *Astragalus leucolobis* and *Castilleja montigena*, and an investigation into the environmental factors that control the complex distribution of the various pinyon-juniper understories characteristic of Broom Flat Ridge.

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APPENDIX A: THE PLANTS OF BROOM FLAT RIDGE

Candidate Research Natural Area

Mary Theresa Burke and Andy Sanders

FERNS AND ALLIES

EQUISETACEAE

Equisetum laevigatum A. Br.

CONIFEROUS PLANTS

CUPRESSACEAE

Juniperus occidentalis Hook. var. *australis* Vasek

PINACEAE

Abies concolor (Gord. & Glend.)Lindl.
Pinus jeffreyi Grev. & Balf. in A.Murr.
Pinus monophylla Torr. & Frem.

DICOTYLEDONS

ASTERACEAE

Artemisia ludoviciana Nutt.
Artemisia tridentata Nutt. ssp. *tridentata*
Chrysothamnus nauseosus (Pall.)Britten
Chrysothamnus parryi (Gray)Greene
Chrysothamnus viscidiflorus (Hook.)Nutt.
Erigeron aphanactis (Gray)Greene
Erigeron breweri Gray var. *breweri*
Eriophyllum confertiflorum (DC.)Gray
Gutierrezia sarothrae (Pursh.)Britt. & Rusby.
Hymenopappus filifolius Hook. var. *lugens* (Greene)Jeps.
Solidago californica Nutt.
Taraxacum officinalis Wiggers.
Tetradymia canescens DC.

BORAGINACEAE

Cryptantha sp.
Cryptantha echinella Greene
Cryptantha pterocarya (Torr.)Greene cf. var. *purpusii* Jeps.

BRASSICACEAE

Arabis pulchra Jones
Caulanthus major (Jones)Pays.
Cordylanthus filifolius Nutt. ex Benth in DC
Draba corrugata Wats.
Erysimum capitatum (Dougl.)Greene

CACTACEAE

Echinocereus engelmannii (Parry)Lem. var. *munzii* (Parish)Pierce & Fosberg
Echinocereus triglochidiatus Engelm.
Opuntia basilaris Engelm. & Bigel var. *basilaris*

CAPRIFOLIACEAE

Symphoricarpus parishii Rydb.

CHENOPODIACEAE

Chenopodium fremontii Wats.

ERICACEAE

Arctostaphylos patula Greene ssp. *platyphylla*

EUPHORBIACEAE

Euphorbia palmeri Engelm.

FABACEAE

Amorpha californica Nutt.
Astragalus leucolobis Jones
Astragalus purshii Dougl. var. *lectulus* Jones

FAGACEAE

Quercus chrysolepis Liebm.

GERANIACEAE

Geranium richardsonii Fisch. & Trautv.

HYDROPHYLLACEAE

Eriodictyon angustifolium Nutt.

LAMIACEAE

Monardella linoides Gray ssp. *stricta* (Parish)Epling
Salvia pachyphylla Epl. ex Munz
Stachys albens Gray

ONAGRACEAE

Oenothera caespitosa Nutt. var. *marginata* (Nutt.)Munz

POLEMONIACEAE

Gilia diegensis (Munz)A.& V.Grant
Leptodactylon pungens (Torr)Rydb. ssp. *hallii* (Parish)Mason
Linanthus sp.

POLYGONACEAE

Eriogonum davidsonii Greene
Eriogonum fasciculatum Benth. var. *polifolium* (Benth.)Stokes
Eriogonum micranthecum Nutt. var. *corymbosoides* Reveal
Eriogonum parishii Wats.
Eriogonum umbellatum Torr. ssp. *munzii* (Reveal)Thorne ex Munz
Eriogonum wrightii Torr. ex Benth. ssp. *subscaposum* (Wats.)Stokes

RANUNCULACEAE

Aquilegia formosa Fisch. in DC. var. *pauciflora* (Greene)Boothman

RHAMNACEAE

Ceanothus cordulatus Kell.

ROSACEAE

Cercocarpus ledifolius Nutt.
Potentilla glandulosa Lindl.
Potentilla wheeleri Wats.
Purshia glandulosa Curran
Rosa californica C. & S.
Rosa woodsii Lindl.

RUBIACEAE

Galium angustifolium Nutt. ssp. *gabrielense* (M. & J.)Demp. & Steb.
Galium parishii Hilend & Howell

SALICACEAE

Populus tremuloides Michx.
Salix lasiolepis Benth.
Salix scouleriana Barr.

SAXIFRAGACEAE

Ribes cereum Dougl.

SCROPHULARIACEAE

Castilleja miniata Dougl. ex. Hook.
Castilleja montigena Heckard
Mimulus pilosus (Benth.)Wats.
Mimulus rubellus Gray in Torr.
Orobanche californica C.& S. ssp. *feudgeii* (Munz)Heckard
Penstemon grinnellii Eastw. ssp. *grinnellii* (Jones)Munz

MONOCOTYLEDONS

CYPERACEAE

Carex cf. *senta* Boott.
Carex alma Bailey

LILIACEAE

Smilacina stellata (L.)Desf.

POACEAE

Bouteloua gracilis (Willd. ex HBK)Lag.
Bromus tectorum L.
Hesperochloa kingii (Wats.)Rydb.
Oryzopsis hymenoides (R.& S.)Ricker
Poa fendleriana (Steud.)Vasey
Sitanion hystrix (Nutt.)J.G. Sm.
Stipa comata Trin. & Rupr.
Stipa coronata Thurb. in Wats.
Stipa elmeri Piper & Brodie ex Scribn.

APPENDIX B: CHECKLIST OF PLANTS OF BROOM FLAT RIDGE

Candidate Research Natural Area
Mary Burke and Andy Sanders
1991

All page numbers refer to Munz' "A Flora of Southern California", except where preceded by an "M...". These numbers refer to Munz and Keck's "A California Flora".

Family	PgNo	Plant Name	Plant Notes
PIN	38	Abies concolor	erect solitary needles
FAB	422	Amorpha californica	
RAN	721	Aquilegia formosa var. pauciflora	
BRA	273	Arabis pulchra	Purple flowers, lvs 4-8 cm long. Fairly common perennial/biennial in open areas.
ERI	400	Arctostaphylos patula ssp. platyphylla	Uncommon shrub in brushy areas, common on burn to east. Broad ovate lvs, truncate base.
AST	117	Artemisia ludoviciana	Peren. herb, whitish lobed lvs.
AST	119	Artemisia tridentata ssp. tridentata	Sessile lvs w/3 blunt teeth.
FAB	432	Astragalus leucolobis	CNPS List 1B
FAB	434	Astragalus purshii var. lectulus	Scarce perennial herb. Low, shaggy, villous, rose to lavender flws, inflated wooly pods.
POA	949	Bouteloua gracilis	
POA	956	Bromus tectorum	drooping reddish inflor.
CYP	885	Carex cf. senta	black carex
CYP	885	Carex alma	
SCR	797	Castilleja miniata	
SCR	797	Castilleja montigena [C. martinii var. ewanii]	Locally common perennial in open areas at edge. CNPS List(Hecker et al, 1980).
BRA	283	Caulanthus major	
RHA	733	Ceanothus cordulatus	common low shrub, spiny, grayish lvs.
ROS	743	Cercocarpus ledifolius	Common large shrub or small tree.
CHE	361	Chenopodium fremontii	
AST	142	Chrysothamnus nauseosus	Infl. strongly clustered at top, twigs tomentose, linear lvs.
AST	144	Chrysothamnus parryi	Infl. loose, lvs linear with little clusters at base, no rays.
AST	145	Chrysothamnus viscidiflorus	1-2 ft shrub, green twisted (spiral) lvs.
BRA	801	Cordylanthus filifolius	branching herb, dissected lvs, ridgetop, full sun, gravelly soil
BOR	251	Cryptantha sp.	
BOR	251	Cryptantha echinella	
BOR	251	Cryptantha pterocarya var. purpusii	
BRA	288	Draba corrugata	small hairy rosette
CAC	311	Echinocereus engelmannii var. munzii	Sensitive plant species. "Growing in crevice on north side of a large boulder on the main ridge".
CAC	312	Echinocereus triglochidiatus	A scarce succulent perennial. Dense mounds to 1 ft, red flws, webby straight spines.
EQU	16	Equisetum laevigatum	single black whorl
AST	160	Erigeron aphanactis	
AST	160	Erigeron breweri var. breweri	
HYD	497	Eriodictyon angustifolium	sticky shiny lvs; flw 2-4 mm
POL	683	Eriogonum davidsonii	axillary flws, very tomentose basal lvs, annual
POL	684	Eriogonum fasciculatum var. polifolium	Uncommon subshrub, 2-8 dm, shrubby, clustered infl, linear lvs.
POL	691	Eriogonum micranthecum var. corymbosoides	Uncommon subshrub; 4-6 dm, no clustered infl, flw red to brown.
POL	693	Eriogonum parishii	airy infl.
POL	697	Eriogonum umbellatum ssp. munzii	
POL	697	Eriogonum wrightii ssp. subscaposum	Low silvery, loosely matted, branched flw stalk, E. kennedyi smaller.
AST	163	Eriophyllum confertiflorum	Yellow yarrow-like flowers; toother 3-lobed lvs: green above, white below.
BRA	290	Erysimum capitatum	Spreading siliques.
EUP	413	Euphorbia palmeri	Flat lvs, milky juice.
RUB	764	Galium angustifolium ssp. gabrielense	
RUB	769	Galium parishii	Fairly common perennial herb.
GER	492	Geranium richardsonii	whitish flw, purple veins; purple glands on pedicel
POL	649	Gilia diegensis	
AST	174	Gutierrezia sarothrae	Numerous resinous heads, linear lvs, 1 mm; rays present.
POA	974	Hesperochloa kingii	Uncommon, coarse, clump-forming perennial.
AST	193	Hymenopappus filifolius var. lugens	
CUP	37	Juniperus occidentalis var. australis	Common tree. Blue-black berry.
POL	657	Leptodactylon pungens ssp. hallii	

POL	659	Linanthus sp.	
SCR	814	Mimulus pilosus	small, villous, yellow
SCR	814	Mimulus rubellus	tall w/purple flw, redribbed calyx
LAM	530	Monardella linoides ssp. stricta	Uncommon subshrub in rocky areas. Stems silvery, lvs green.
ONA	613	Oenothera caespitosa var. marginata	
CAC	315	Opuntia basilaris var. basilaris	Uncommon succulent. Broad joints, pink flws.
SCR	618	Orobanche californica ssp. feudgeii	
POA	985	Oryzopsis hymenoides	
SCR	822	Penstemon grinnellii ssp. grinnellii	inflated sky blue flws
PIN	39	Pinus jeffreyi	common along drainage immediately to west.
PIN	40	Pinus monophylla	Abundant, dominant tree.
POA	994	Poa fendleriana	very common clump-forming perennial.
SAL	772	Populus tremuloides	along dry tributary, north end
ROS	753	Potentilla glandulosa	tall w/creamy flowers, pinnate compound lvs., moist areas
ROS	755	Potentilla wheeleri	palmate and low, a bit silvery, mwds
ROS	758	Purshia glandulosa	Uncommon shrub.
FAG	480	Quercus chrysolepis	
SAX	785	Ribes cereum	no spines, long tube, lobed lvs
ROS	759	Rosa californica	flattened curved spines
ROS	759	Rosa woodsii	spines straight, slender, not curved
SAL	775	Salix lasiolepis	
SAL	776	Salix scouleriana	fairly common along western margin
LAM	538	Salvia pachyphylla	
POA	999	Sitanion hystrix	Common clump-forming perennial, bristly inflor.
LIL	929	Smilacina stellata	flowers few
AST	228	Solidago californica	Perennial herb, broad lvs.
LAM	541	Stachys albens	dense cobwebby hairs
POA	1004	Stipa comata	Long hairless awn coils, single bend.
POA	1004	Stipa coronata	Fairly common clump-forming perennial.
POA	1004	Stipa elmeri	Uncommon clump-forming perennial.
CAP	334	Symphoricarpus parishii	San Bern. montane sp.
AST	234	Taraxacum officinalis	lyrate lvs, calyx recurved, bright yellow. rare T. californicum: entire; upright; pale yellow
AST	235	Tetradymia canescens	White tomentose composite.

APPENDIX C: PREDICTED WILDLIFE OF BROOM FLAT RIDGE

California Department of Fish and Game Wildlife Habitat Relationship System (Timossi, 1989)

Steve Loe, Forest Wildlife Biologist, USFS San Bernardino National Forest

Status Definitions:

- FE: Federally Endangered
- FT: Federally Threatened
- CE: California Endangered
- CT: California Threatened
- CP: California Protected
- FS: Forest Service Sensitive
- BS: BLM Sensitive
- H : Harvest Species
- CalSC: California Species of Special Concern

ID#	Common Name	Scientific Name	Family	Status
AMPHIBIANS				
A012	Ensatina	Ensatina eschscholtzi	Plethodontidae	
BIRDS				
B108	Turkey Vulture	Cathartes aura	Cathartida	
B115	Sharp-Shinned Hawk	Accipiter striatus	Accipitridae	CalSC
B116	Cooper's Hawk	Accipiter cooperii	Accipitridae	CalSC
B117	Northern Goshawk	Accipiter gentilis	Accipitridae	FS; CalSC
B123	Red-Tailed Hawk	Buteo jamaicensis	Accipitridae	
B124	Ferruginous Hawk	Buteo regalis	Accipitridae	CalSC
B125	Rough-Legged Hawk	Buteo lagopus	Accipitridae	
B126	Golden Eagle	Aquila chrysaetos	Accipitridae	CP;FS; CalSC
B127	American Kestrel	Falco sparverius	Falconidae	
B128	Merlin	Falco columbarius	Falconidae	CalSC
B131	Prairie Falcon	Falco mexicanus	Falconidae	FS
B140	California Quail	Callipepla californica	Phasianidae	H
B141	Mountain Quail	Oreortyx pictus	Phasianidae	H
B251	Band-Tailed Pigeon	Columba fasciata	Columbiadae	H
B255	Mourning Dove	Zenaida macroura	Columbidae	H
B262	Common Barn Owl	Tyto alba	Tytonidae	
B263	Flammulated Owl	Otus flammeolus	Strigidae	
B264	Western Screech Owl	Otus kennicottii	Strigidae	
B265	Great Horned Owl	Bubo virginianus	Strigidae	
B267	Northern Pygmy Owl	Glaucidium gnoma	Strigidae	
B270	Spotted Owl	Strix occidentalis	Strigidae	FS; CalSC
B272	Long-Eared Owl	Asio otus	Strigidae	CalSC
B274	Northern Saw-Whet Owl	Aegolius acadicus	Strigidae	
B276	Common Nighthawk	Cordeiles minor	Caprimulgidae	
B277	Common Poorwill	Phalaenoptilus nuttallii	Caprimulgidae	
B278	Whip-Poor-Will	Caprimulgus vociferus	Caprimulgidae	
B287	Anna's Hummingbird	Calypte anna	Trochilidae	
B289	Calliope Hummmingbird	Stellula calliope	Trochilidae	
B294	Lewis' Woodpecker	Melanerpes lewis	Picidae	
B298	Red-Naped Sapsucker	Sphyrapicus nuchalis	Picidae	
B299	Red-Breasted Sapsucker	Sphyrapicus ruber	Picidae	
B300	Williamson's Sapsucker	Sphyrapicus thyroideus	Picidae	
B304	Hairy Woodpecker	Picoides villosus	Picidae	
B305	White-headed Woodpecker	Picoides albolarvatus	Picidae	
B307	Northern Flicker	Colaptes auratus	Picidae	

B309	Olive-sided Flycatcher	Contopus borealis	Tyrannidae	
B311	Western Wood-Pewee	Contopus sordidulus	Tyrannidae	
B318	Dusky Flycatcher	Empidonax oberholseri	Tyrannidae	
B319	Gray Flycatcher	Empidonax wrightii	Tyrannidae	
B333	Western Kingbird	Tyrannus verticalis	Tryannidae	
B340	Violet-Green Swallow	Tachycineta thalassina	Hirundinidae	
B346	Steller's Jay	Cyanocitta stelleri	Corvidae	
B348	Scrub Jay	Aphelocoma coerulescens	Corvidae	
B349	Pinyon Jay	Gymnorhinus cyanocephalus	Corvidae	
B350	Clark's Nutcracker	Nucifraga columbiana	Corvidae	
B353	American Crow	Corvus brachyrhynchos	Corvidae	H
B354	Common Raven	Corvuus corax	Corvidae	
B356	Mountain Chickadee	Parus gambeli	Paridae	
B360	Bushtit	Psaltriparus minimus	Aegithalidae	
B361	Red-Breasted Nuthatch	Sitta canadensis	Sittidae	
B362	White-Breasted Nuthatch	Sitta carolinesis	Sittidae	
B363	Pygmy Nuthatch	Sitta pygmaea	Sittidae	
B364	Brown Creeper	Certhia americana	Certhiidae	
B368	Bewick's Wren	Thryomanes bewickii	Troglodytidae	
B375	Golden-Crowned Kinglet	Regulus satrapa	Muscicapidae	
B376	Ruby-Crowned Kinglet	Regulus calendula	Muscicapidae	
B377	Blue-Gray Gnatcatcher	Polioptila caerulea	Muscicapidae	CalSC
B380	Western Bluebird	Sialia mexicana	Muscicapidae	
B381	Mountain Bluebird	Sialia currucoides	Muscicapidae	
B382	Townsend's Solitaire	Myadestes townsendi	Muscicapidae	
B386	Hermit Thrush	Catharus guttatus	Muscicapidae	
B391	Wrentit	Chamaea fasciata	Muscicapidae	
B411	European Starling	Sturnus vulgaris	Sturnidae	
B418	Warbling Vireo	Vireo gilvus	Vireonidae	
B425	Orange-Crowned Warbler	Vermivora celata	Emberizidae	
B426	Nashville Warbler	Vermivora ruficapilla	Emberizidae	
B430	Yellow Warbler	Dendroica petechia	Emberizidae	CalSC
B435	Yellow-Rumped Warbler	Dendroica coronata	Emberizidae	
B436	Black-Throated Gray Warbler	Dendroica nigrescens	Emberizidae	
B437	Townsend's Warbler	Dendroica townsendi	Emberizidae	
B438	Hermit Warbler	Dendroica occidentalis	Emberizidae	
B463	Wilson's Warbler	Wilsonia pusilla	Emberizidae	
B471	Western Tanager	Piranga ludoviciana	Emberizidae	
B477	Lazuli Bunting	Passerina amoena	Emberizidae	
B504	Fox Sparrow	Passerella iliaca	Emberizidae	CalSC
B506	Lincoln's Sparrow	Melospiza lincolnii	Emberizidae	
B510	White-Crowned Sparrow	Zonotrichia leucophrys	Emberizidae	
B512	Dark-Eyed Junco	Junco hyenalis	Emberizidae	
B521	Western Meadowlark	Sturnella neglecta	Emberizidae	
B528	Brown-Headed Cowbird	Molothrus ater	Emberizidae	
B536	Purple Finch	Carpodacus purpureus	Fringillidae	
B537	Cassin's Finch	Carpodacus cassinii	Fringillidae	
B539	Red Crossbill	Loxia curvirostra	Fringillidae	
B542	Pine Siskin	Carduelis pinus	Fringillidae	
B543	Lesser Goldfinch	Carduelis psaltria	Fringillidae	
B546	Evening Grosbeak	Coccothraustes vespertinus	Fringillidae	CalSC

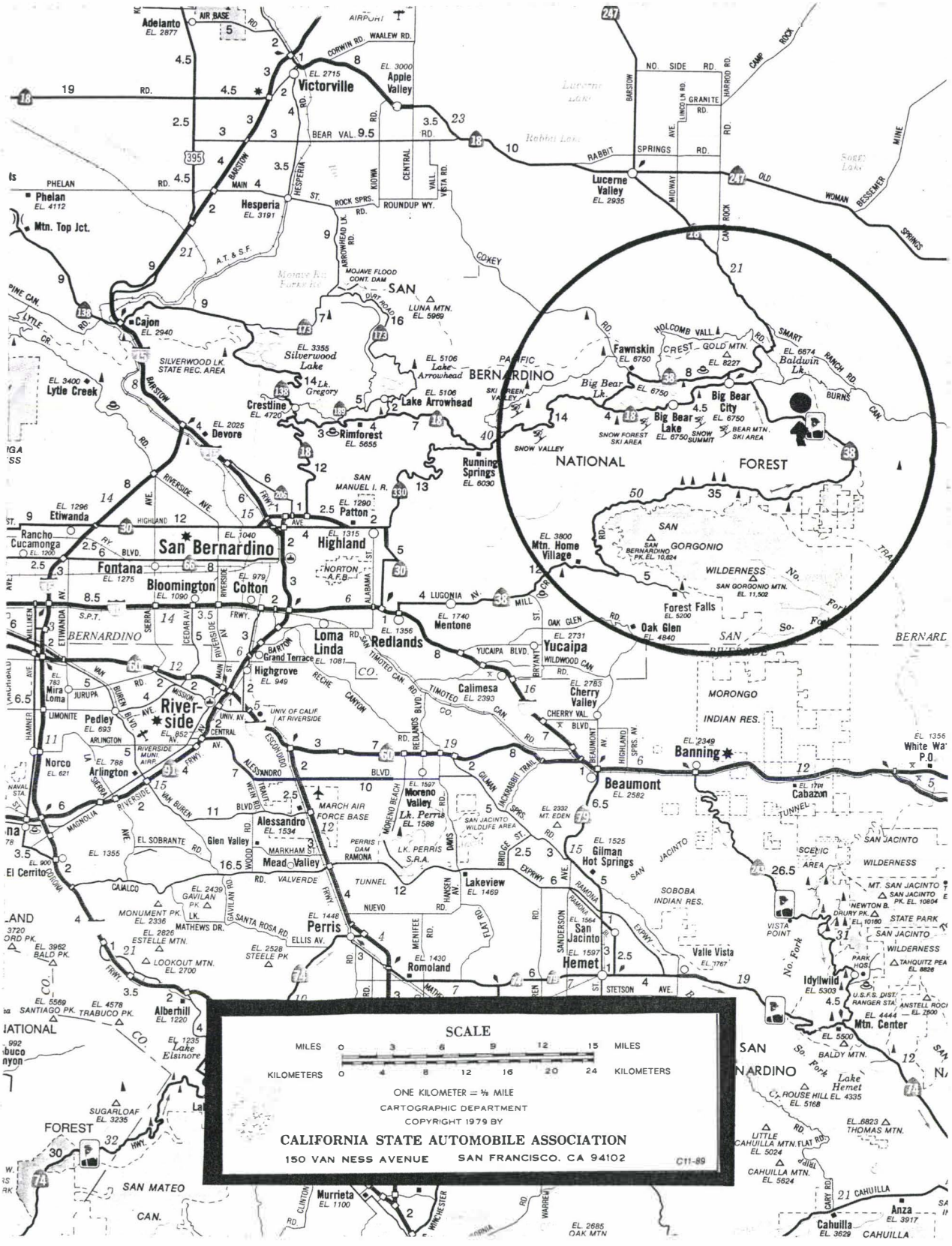
MAMMALS

M004	Dusky Shrew	Sorex monticolus	Soricidae	
M018	Broad-footed Mole	Scapanus latimanus	Talpidae	
M021	Little Brown Myotis	Myotis lucifugus	Vespertilionidae	
M023	Yuma Myotis	Myotis yumanensis	Vespertilionidae	
M025	Long-Eared Myotis	Myotis evotis	Vespertilionidae	

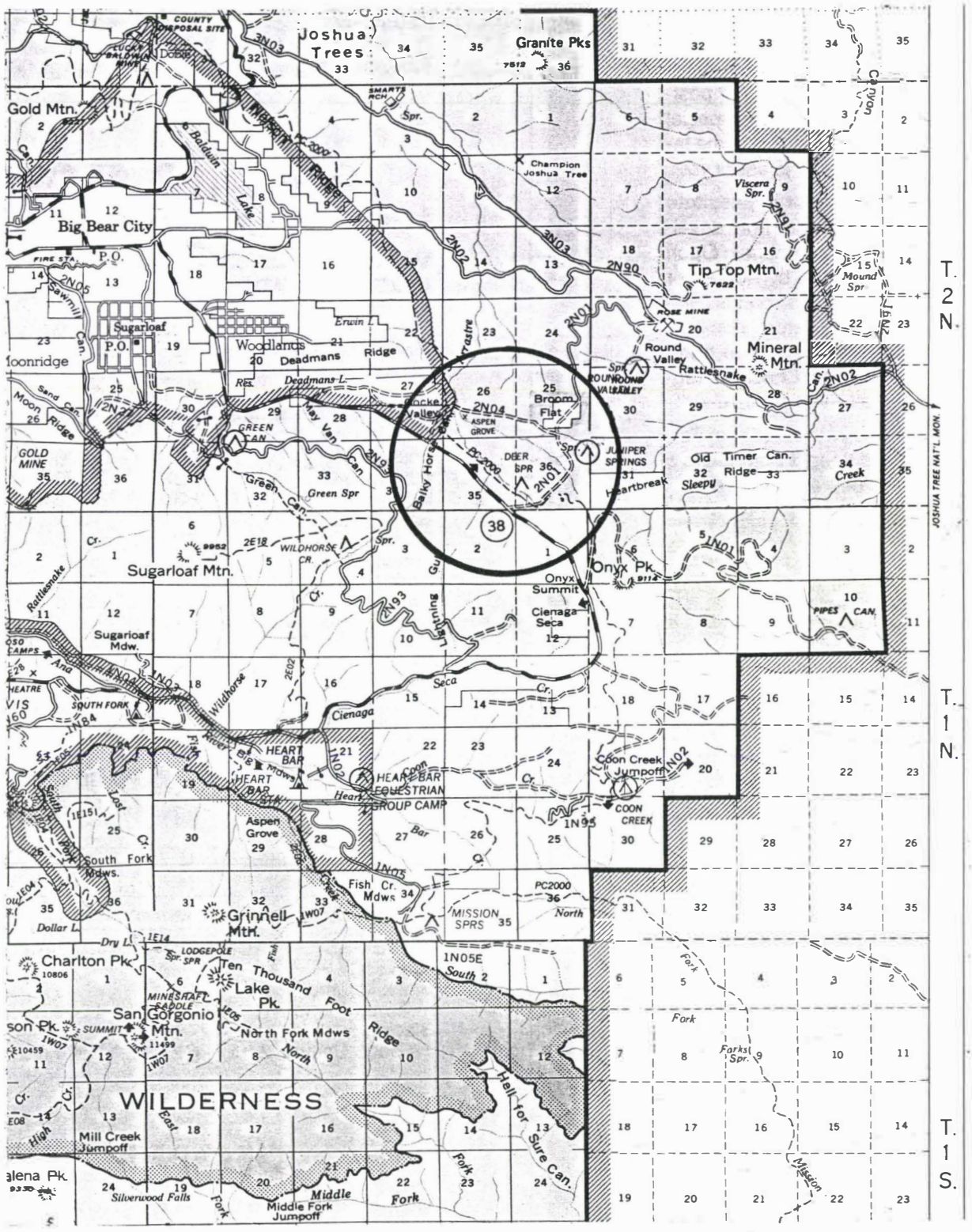
M026	Fringed Myotis	Myotis thysanoides	Vespertilionidae	
M027	Long-Legged Myotis	Myotis volans	Vespertilionidae	
M028	California Myotis	Myotis californica	Vespertilionidae	
M029	Small-Footed Myotis	Myotis leibii	Vespertilionidae	
M031	Western Pipistrelle	Pipistrellus hesperus	Vespertilionidae	
M032	Big Brown Bat	Eptesicus fuscus	Vespertilionidae	
M033	Red Bat	Lasiurus borealis	Vespertilionidae	
M034	Hoary Bat	Lasiurus cinereus	Vespertilionidae	
M036	Spotted Bat	Euderma maculatum	Vespertilionidae	CalSC
M037	Townsend's Big-Eared Bat	Plecotus townsendii	Vespertilionidae	CalSC
M038	Pallid Bat	Antrozous pallidus	Vespertilionidae	CalSC
M039	Brazilian Free-Tailed Bat	Tadarida brasiliensis	Molossidae	
M042	Western Mastiff Bat	Eumops perotis	Molossidae	CalSC
M051	Black-Tailed Hare	Lepus californicus	Leporidae	H
M060	Merriam's Chickmunk	Eutamias merriami	Sciuridae	
M061	California Chipmunk	Eutamias obscurus	Sciuridae	
M063	Lodgepole Chipmunk	Eutamias speciosus	Sciuridae	
M072	California Ground Squirrel	Spermophilus beecheyi	Sciuridae	
M075	Golden-Mantled Ground Squirrel	Spermophilus lateralis	Sciuridae	
M077	Western Gray Squirrel	Sciurus griseus	Sciuridae	H
M113	Western Harvest Mouse	Reithrodontomys megalotis	Cricetidae	CalSC
M116	California Mouse	Peromyscus californicus	Cricetidae	
M117	Deer Mouse	Peromyscus maniculatus	Cricetidae	CalSC
M119	Brush Mouse	Peromyscus boylii	Cricetidae	
M120	Pinyon Mouse	Peromyscus truei	Cricetidae	
M126	Desert Woodrat	Neotoma lepida	Cricetidae	
M127	Dusky-Footed Woodrat	Neotoma fuscipes	Cricetidae	CalSC
M145	Porcupine	Erethizon dorsatum	Erethizontidae	
M146	Coyote	Canis latrans	Canidae	H
M149	Gray Fox	Urocyon cinereoargenteus	Canidae	H
M151	Black Bear	Ursus americanus	Ursidae	H
M153	Raccoon	Procyon lotor	Procyonidae	H
M157	Long-Tailed Weasel	Mustela frenata	Mustelidae	H
M160	Badger	Taxidea taxus	Mustelidae	H; CalSC
M165	Mountain Lion	Felis concolor	Felidae	H; CalSC
M175	Feral Burro	Equus asinus	Equidae	
M181	Mule Deer	Odocoileus hemionus	Cervidae	H

REPTILES

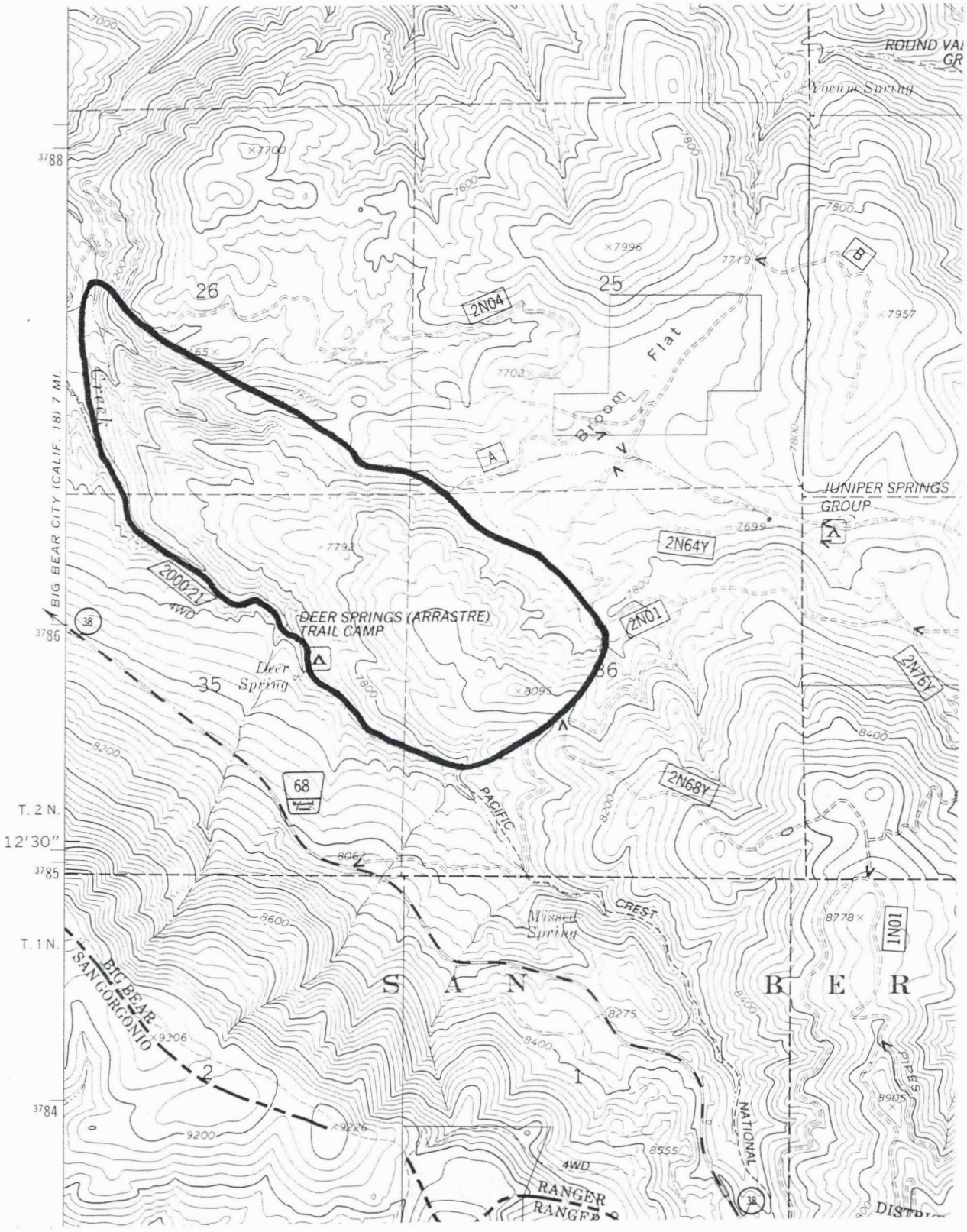
R022	Western Fence Lizard	Sceloporus occidentalis	Iguanidae
R023	Sagebrush Lizard	Sceloporus graciosus	Iguanidae
R039	Western Whiptail	Cnemidophorus tigris	Teiidae
R040	Southern Alligator Lizard	Gerrhonotus multicarinatus	Anguidae
R046	Rubber Boa	Charina bottae	Boidae
R059	California Mountain Kingsnake	Lampropeltis zonata	Colubridae
R061	Common Garter Snake	Thamnophis sirtalis	Colubridae
R062	Western Terrestrial Garter Snake	Thamnophis elegans	Colubridae
R063	Western Aquatic Garter Snake	Thamnophis couchi	Colubridae
R076	Western Rattlesnake	Crotalus viridis	Viperidae



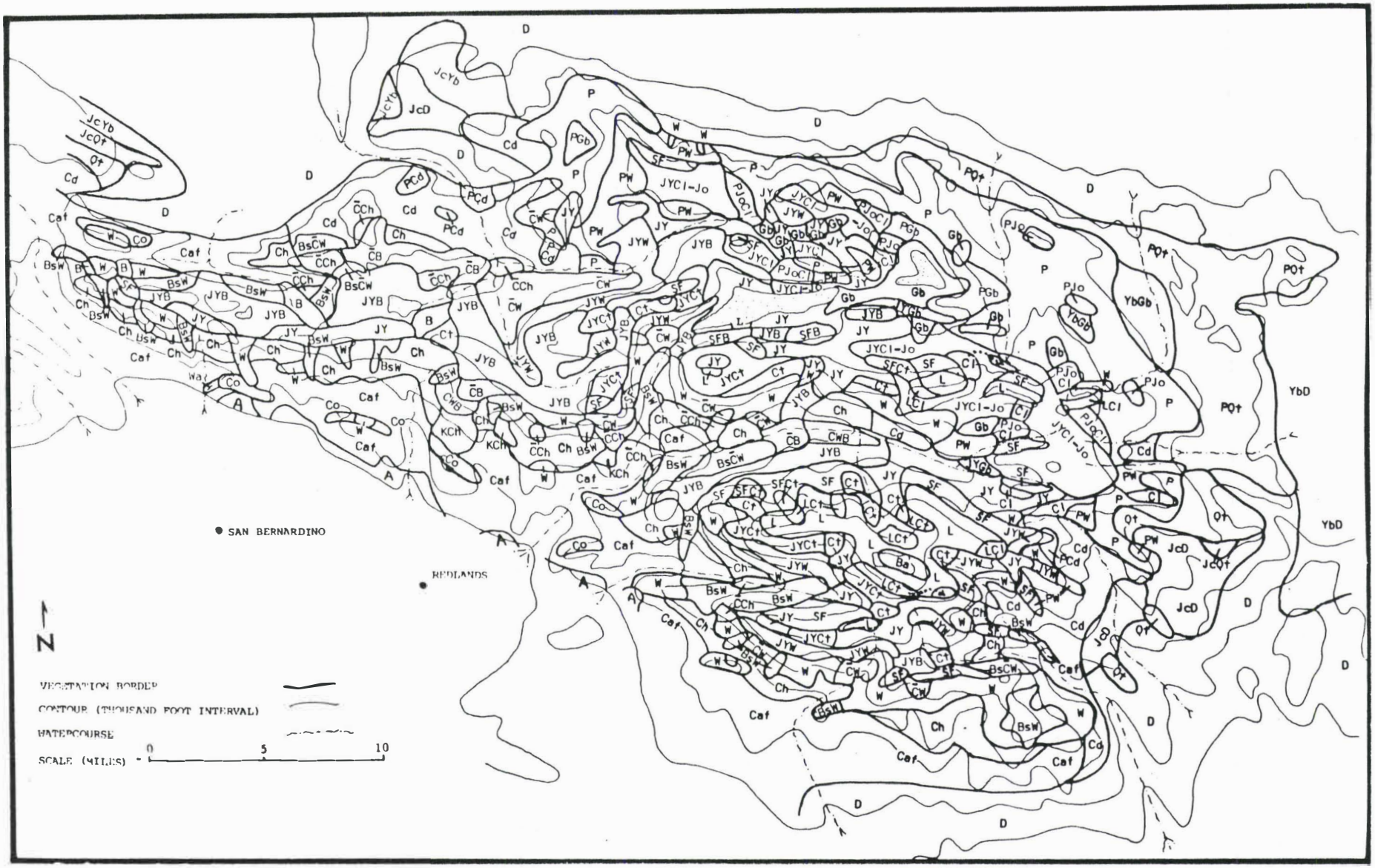
MAP 1. VICINITY MAP. Broom Flat Ridge Candidate Research Natural Area. Big Bear District. San Bernardino National Forest.



MAP 2. US FOREST SERVICE VICINITY MAP.
San Bernardino National Forest Map. San Bernardino Mountain Area. San Bernardino Meridian. 1981.



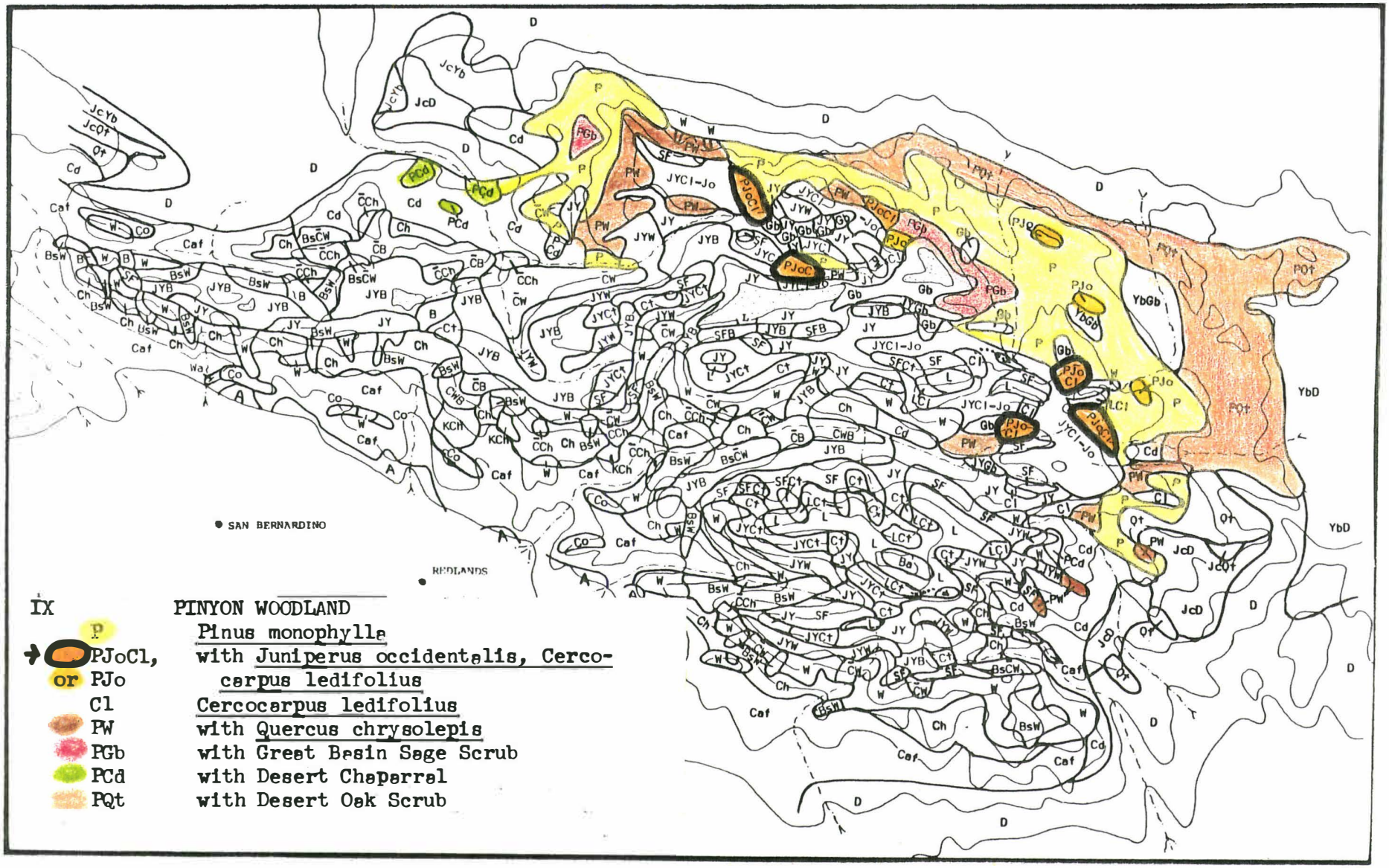
MAP 3. ONYX PEAK, CALIF. (1:24,000).
Broom Flat Ridge Candidate Research Natural Area.
Big Bear District. San Bernardino National Forest.



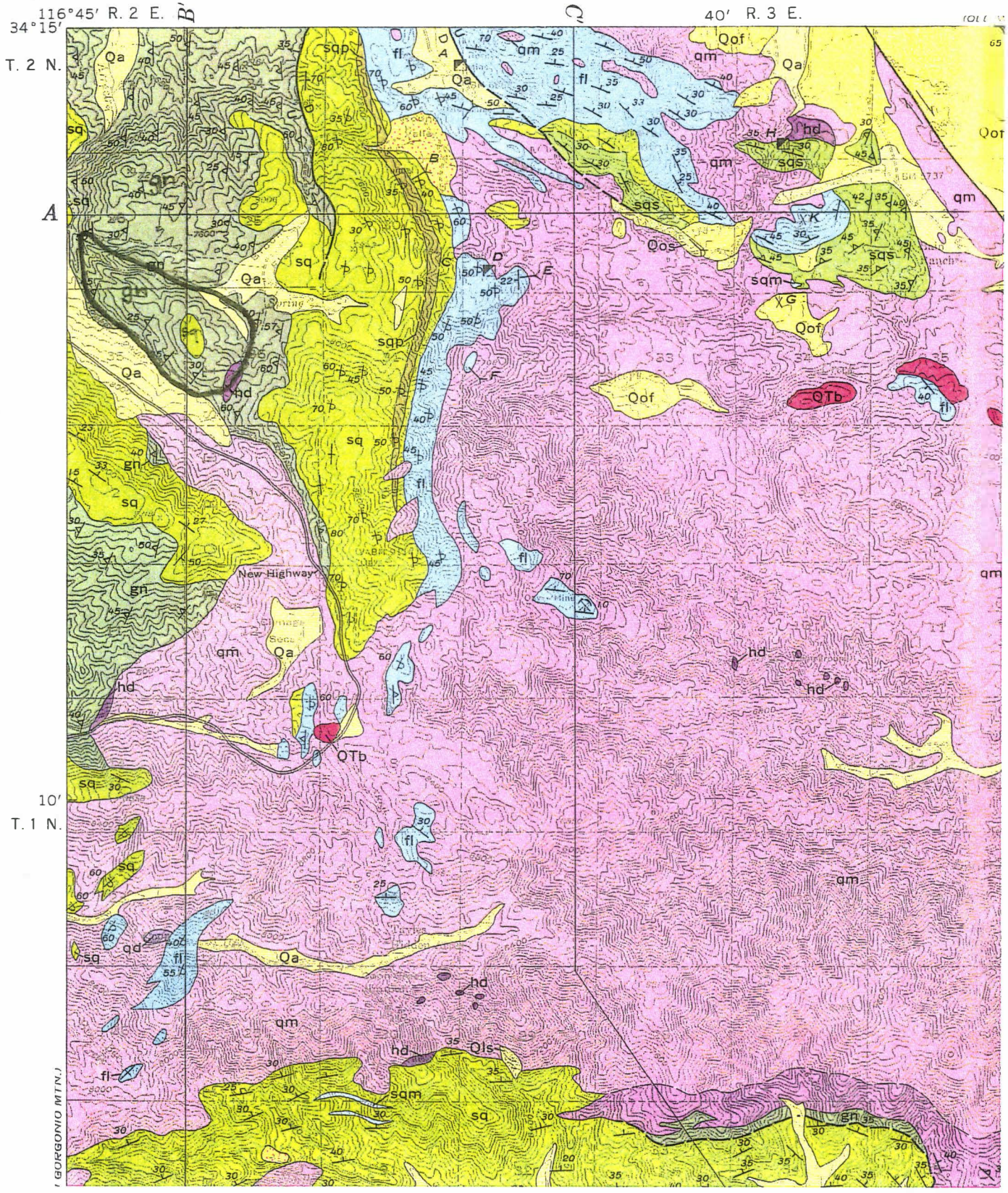
MAP 4. GENERAL VEGETATION MAP OF THE SAN BERNARDINO MOUNTAINS.
Taken in full from Minnick (1976).

KEY FOR GENERAL VEGETATION MAP OF THE SAN BERNARDINO MOUNTAINS.
Taken in full from Minnick (1976).

I	A	CALIFORNIA SAGE SCRUB (Ac,Ef,Ss,Sm)
II	C	CHAPARRAL
	Csf	Chamise Chaparral (Af dominant over other chaparral shrubs)
	Ch	Mixed Chaparral (Ag,Agl,Ccr,Cd,Cb,Qd, Qw, together dominant over Af)
	Co	Oak Chaparral (Qd,Qw dominant over other chaparral shrubs)
	Cd	Desert Chaparral (Cg,Cb,Fc,Ag,Qw together dominant over Qt)
III		OAK WOODLAND
	Ws	Quercus agrifolia
	W	Quercus chrysolepis
IV		CONIFER FORESTS IN CHAPARRAL
	KCh	Pinus attenuata in Mixed Chaparral
	CCh	Pinus coulteri in Mixed Chaparral
	BsW	Pseudotsuga macrocarpa, Quercus chrysolepis
V		MARGINAL FORESTS
	CW	Pinus coulteri, Quercus chrysolepis
	CB	Pinus coulteri, Quercus kelloggii
	B	Quercus kelloggii
VI		WESTERN CONIFEROUS FOREST
	JY	Pinus jeffreyi, P. ponderosa dominant over P. lambertiana, Abies concolor
	JYW	with Quercus chrysolepis
	JYB	with Quercus kelloggii
	JYCt	with Timberland Chaparral
	JYCl-Jo	with Cercocarpus ledifolius,
or	JYCl	Juniperus occidentalis
	JYGb	with Great Basin Sage Scrub
	SF	Pinus lambertiana, Abies concolor dominant over P. jeffreyi, P. ponderosa
	SFB	with Quercus kelloggii
	SFCt	with Timberland Chaparral
	SFCl	with Cercocarpus ledifolius
VII	Ct	TIMBERLAND CHAPARRAL (Ap,Cco,Cs)
VIII		LODGEPOLE PINE FOREST
	L	Pinus murrayana, P. flexilis
	LCt	with Timberland Chaparral
	LCl	with Cercocarpus ledifolius
IX		PINYON WOODLAND
	P	Pinus monophylla
	PJoCl,	with Juniperus occidentalis, Cercocarpus ledifolius
or	PJo	
	Cl	Cercocarpus ledifolius
	PW	with Quercus chrysolepis
	PGb	with Great Basin Sage Scrub
	PCd	with Desert Chaparral
	PQt	with Desert Oak Scrub
X	Gb	GREAT BASIN SAGE SCRUB (Atr,Chn,Pg)
XI	Qt	DESERT OAK SCRUB (Qt dominant over Cg,Cb,Fc,Qw)
XII		JUNIPER WOODLAND (Juniperus californica)
	JcQt	with Desert Oak Scrub
	JcYb	with Yucca brevifolia
	JcD	with Desert Vegetation
XIII		JOSHUA TREE WOODLAND (Yucca brevifolia)
	YbGb	with Great Basin Sage Scrub
	YbD	with Desert Vegetation
XIV	D	DESERT VEGETATION
XV	Ba	BARREN



MAP 5. PINYON VEGETATION TYPES IN THE SAN BERNARDINO MOUNTAINS.
Taken in full from Minnick (1976), with color emphasis of vegetation types added by Burke.



MAP 6. GEOLOGIC MAP: BROOM FLAT RIDGE CANDIDATE RESEARCH NATURAL AREA. (from Morongo Valley Quadrangle, Dibblee 1967).

GEOLOGIC MAP LEGEND: BROOM FLAT RIDGE (Abstracted from Dibblee, 1967)

PRECAMBRIAN METAMORPHIC ROCKS

gn: Gneissic Rocks. Quartz diorite to quartz monzonite gneiss. Medium to dark-gray medium-grained gneiss composed of quartz, plagioclase, potassic feldspar, biotite, hornblende, muscovite and iron oxides in general order of descreasing abundance.

METASEDIMENTARY ROCKS

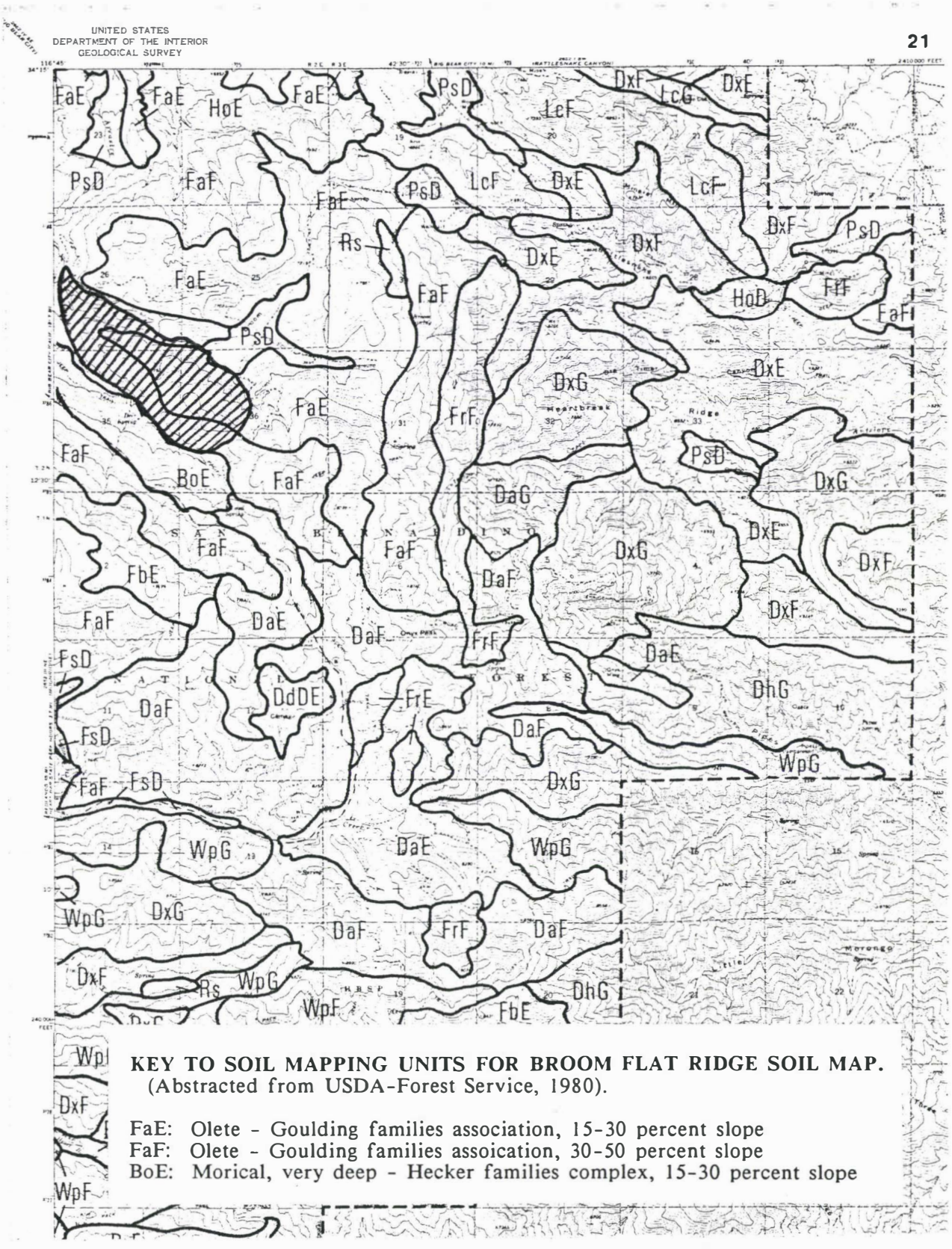
sq: Sargossa Quartzite (quartzite). Gray-white to tan, very hard but brittle, fine-grained quartzite composed mainly of quartz and a little muscovite, biotite and alkali felspar. Brown iron oxide stains common on fractures. Presumably of Paleozoic age.

MESOZOIC PLUTONIC AND HYPABYSSAL IGNEOUS ROCKS

hd: Hornblende biorite or gabbro. dark-gray to black, medium to coarse-grained diorite or gabbro composed mainly of calcic plagioclase and hornblende in variable proportions. Intruded by the quartz monzonite.

SURFICIAL SEDIMENTS AND RUBBLE

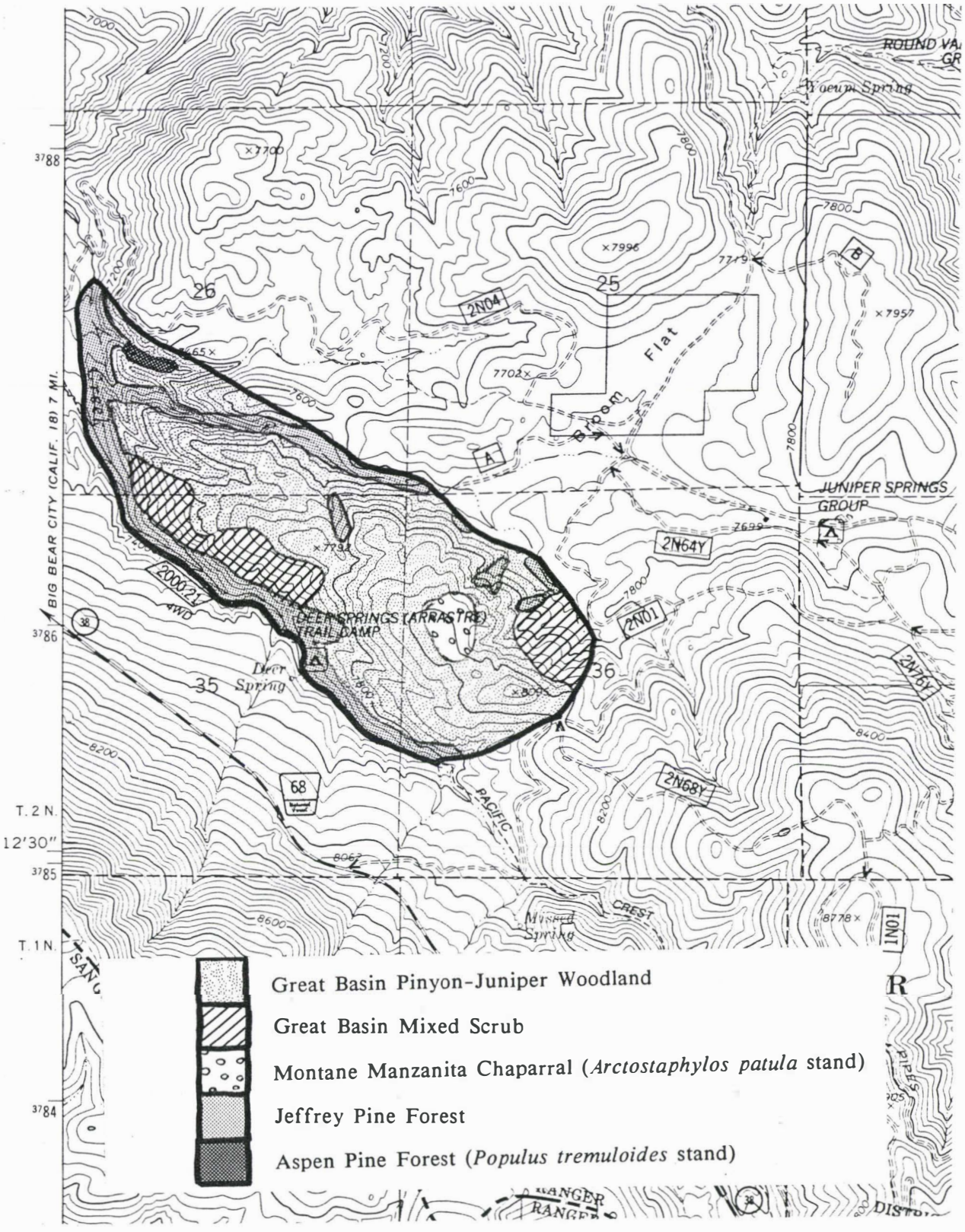
Qa: Alluvium. (Cenozoic). Unconsolidated and generally undissected alluvial fill, in stream channels, mostly gravel of unsorted boulders, cobbles, and pebbles; or a pebbly sand. Age, very late Pleistocene and Recent.



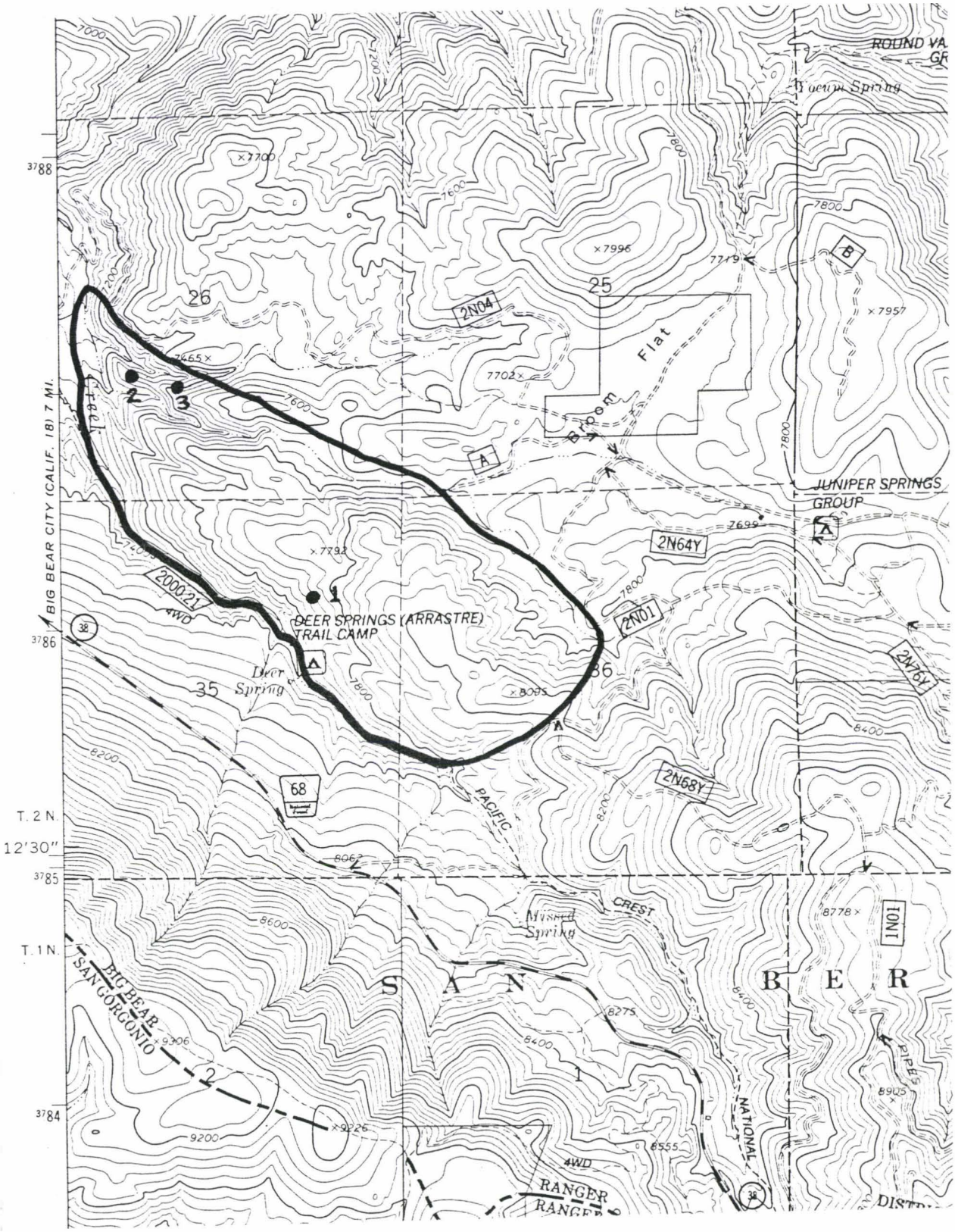
KEY TO SOIL MAPPING UNITS FOR BROOM FLAT RIDGE SOIL MAP.
(Abstracted from USDA-Forest Service, 1980).

FaE: Olete - Goulding families association, 15-30 percent slope
FaF: Olete - Goulding families assoication, 30-50 percent slope
BoE: Morical, very deep - Hecker families complex, 15-30 percent slope

MAP 7. SOIL MAP: BROOM FLAT RIDGE CANDIDATE RESEARCH NATURAL AREA. (USDA-Forest Service 1980).



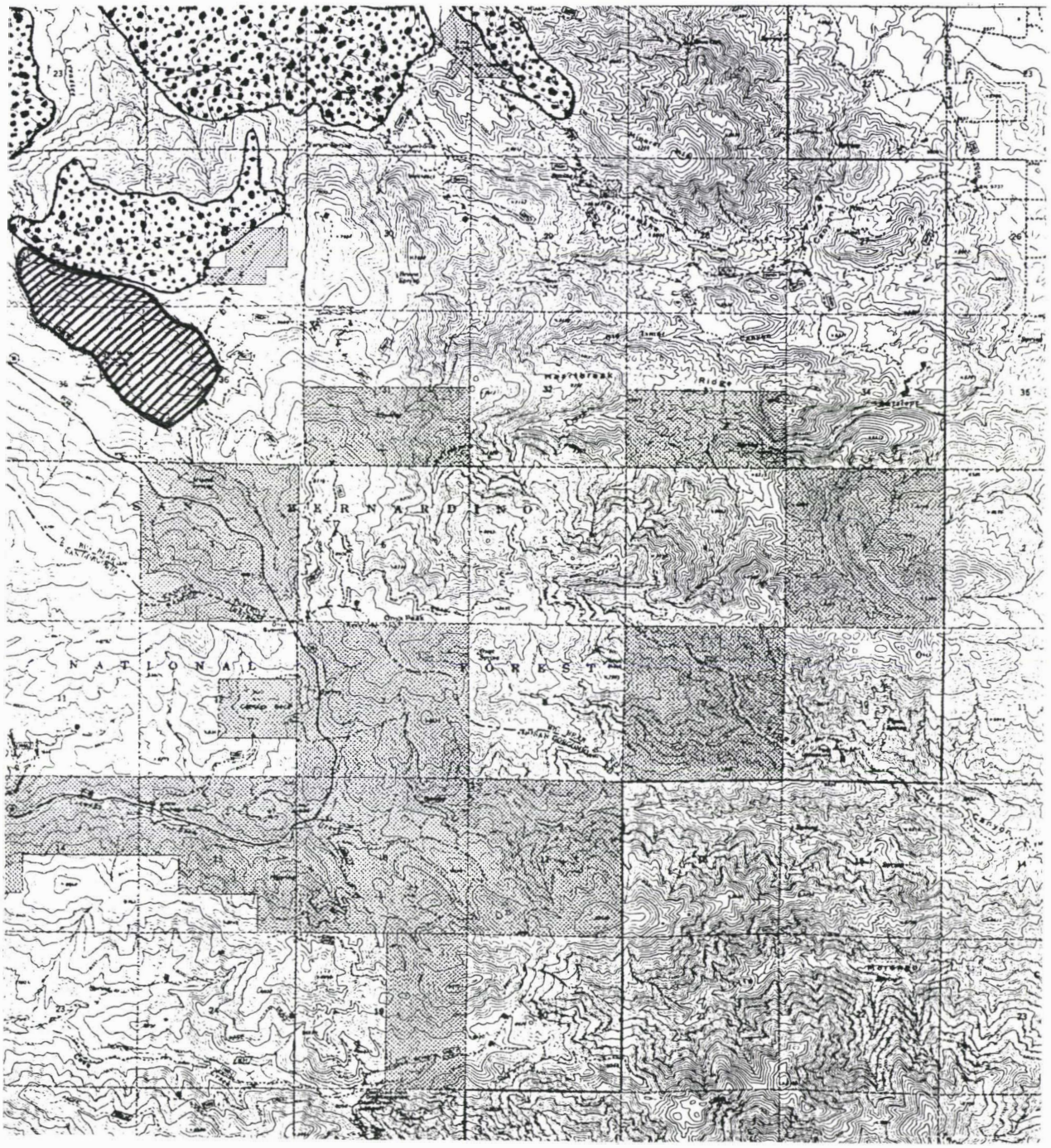
MAP 8. VEGETATION MAP: BROOM FLAT RIDGE CANDIDATE RESEARCH NATURAL AREA.



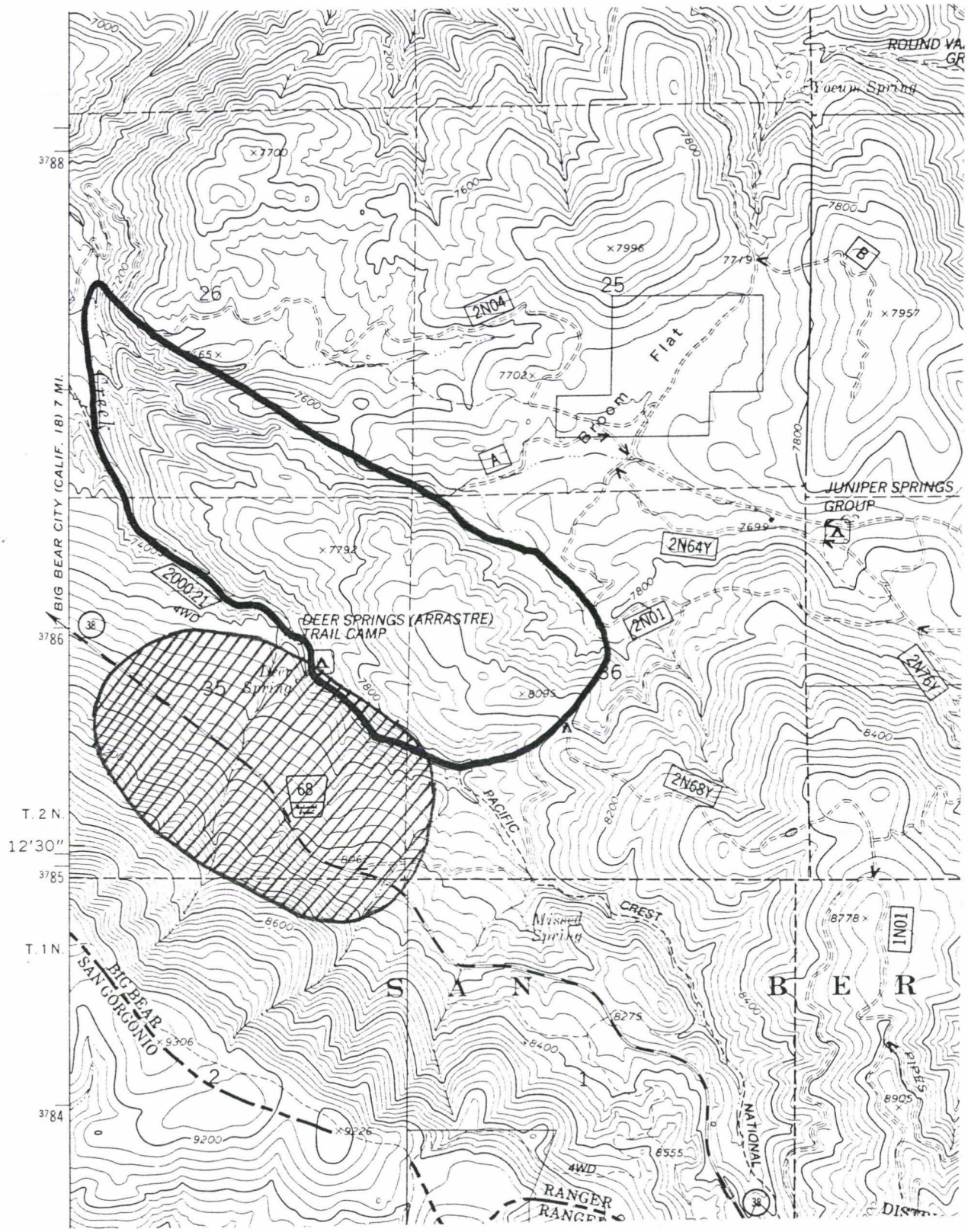
MAP 9. VEGETATION SAMPLING TRANSECTS LOCATION MAP
(A. Sanders 1989; pers. comm.)

Figure A3. *Echinocereus engelmannii* var. *munzii* locations, Baldwin Lake Population, Onyx Peak Quadrangle.

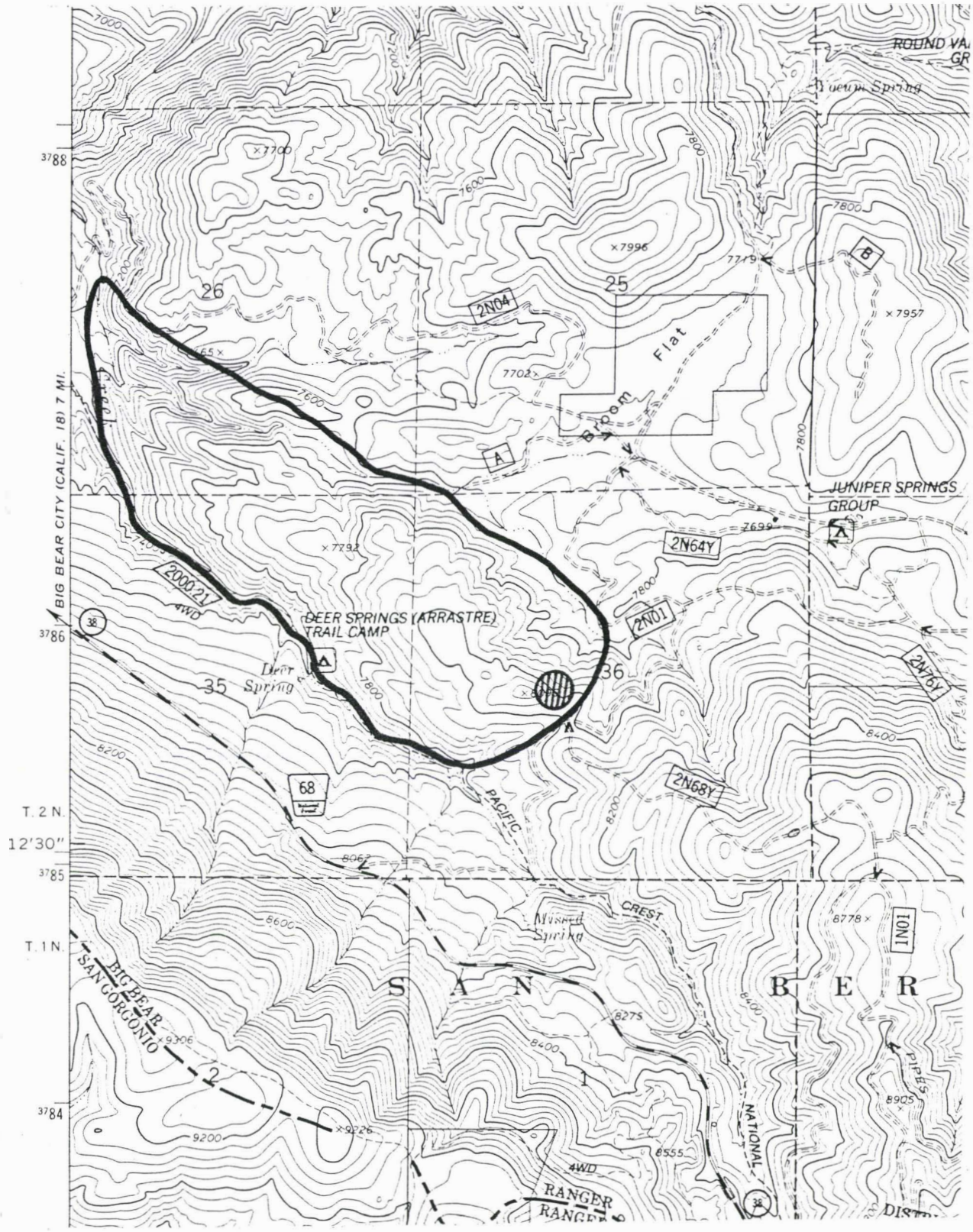
Low Density



MAP 10. NEARBY *Echinocereus engelmannii* var. *munzii* LOCATIONS (Neel 1990).



MAP 11. SPOTTED OWL TERRITORY IN THE BROOM FLAT VICINITY
(Bill LaHaye, pers. comm.)



MAP 12. ARCHAEOLOGICAL SITE WITHIN PROPOSED BROOM FLAT RIDGE BOUNDARIES.
Site Sbr-#4176: "These seem to be sites of seasonal gathering camps, especially for pinyons." (Cultural Systems Research 1981).

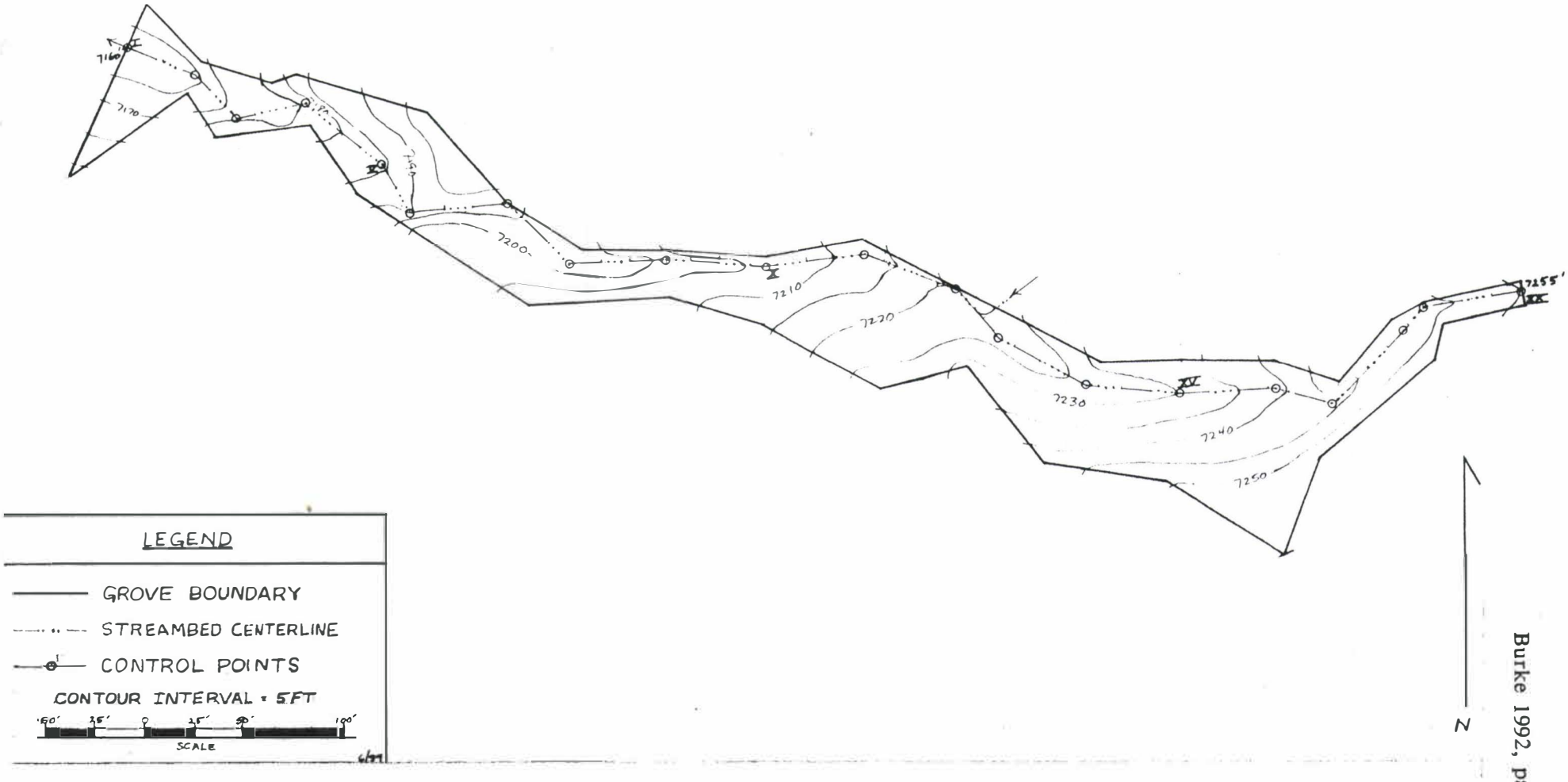


FIGURE 1. Map of Arrastre Creek Aspen Grove
(from Jones, 1989: Fig. 4)

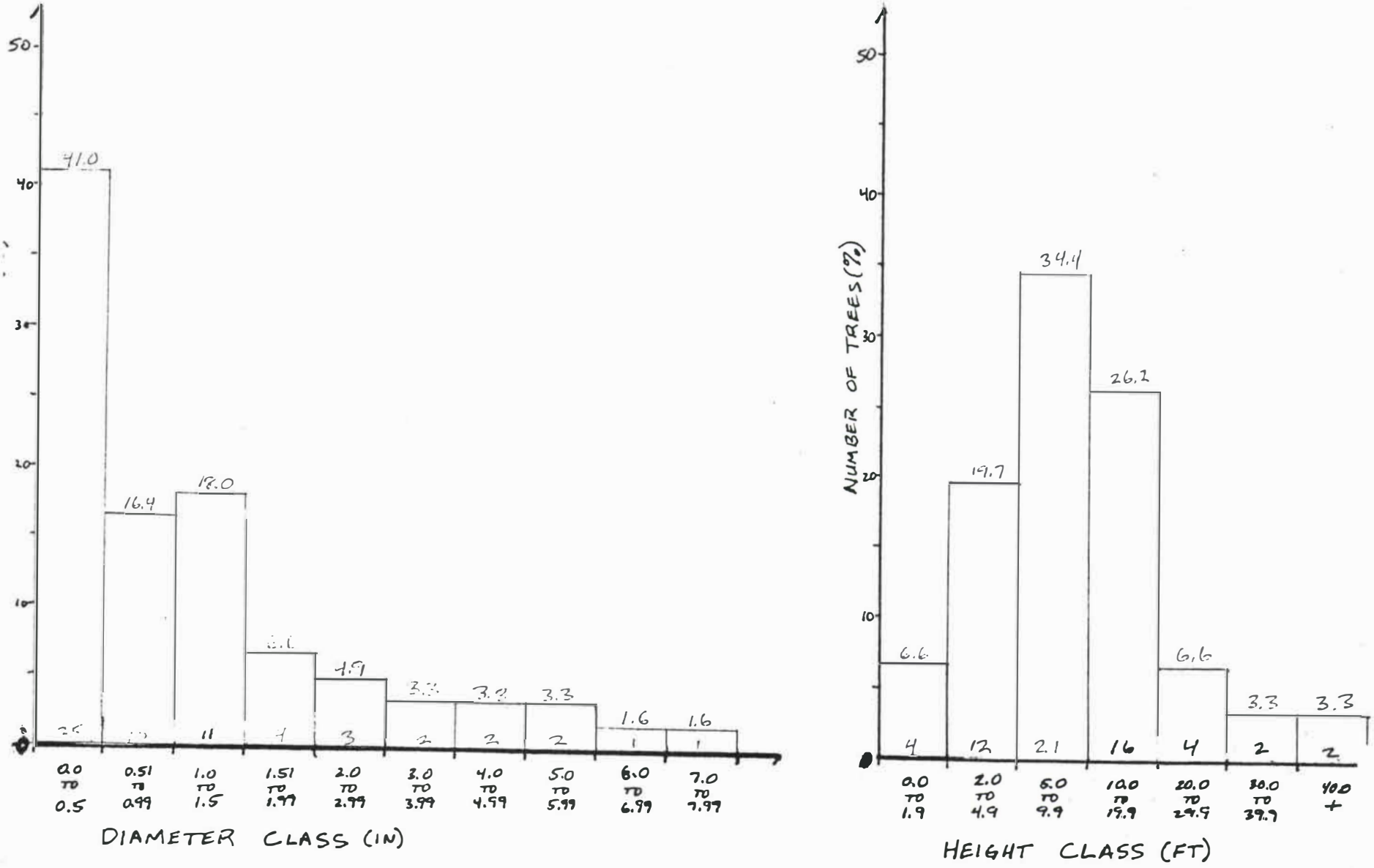


FIGURE 2. Height and Diameter Classes of Arrastre Creek Aspen Grove Sample (from Jones, 1989: Fig. 5A and Fig. 5B)

a.

b.

PLATE 1. BROOM FLAT RIDGE CANDIDATE RESEARCH NATURAL AREA.
General Area Photographs. Big Bear District. San Bernardino National Forest.

PLATE 1. BROOM FLAT RIDGE CANDIDATE RESEARCH NATURAL AREA.
General Area Photographs. Big Bear District. San Bernardino National Forest.

a. Broom Flat Ridge as seen from Highway 38.

b. Broom Flat Ridge as seen from Broom Flat, east of the ridge.

PLATE 2. BROOM FLAT RIDGE. Natural Color Aerial Photograph. 14 October 1983. Soil Conservation Service 615120-983-37 and 615120-983-97.

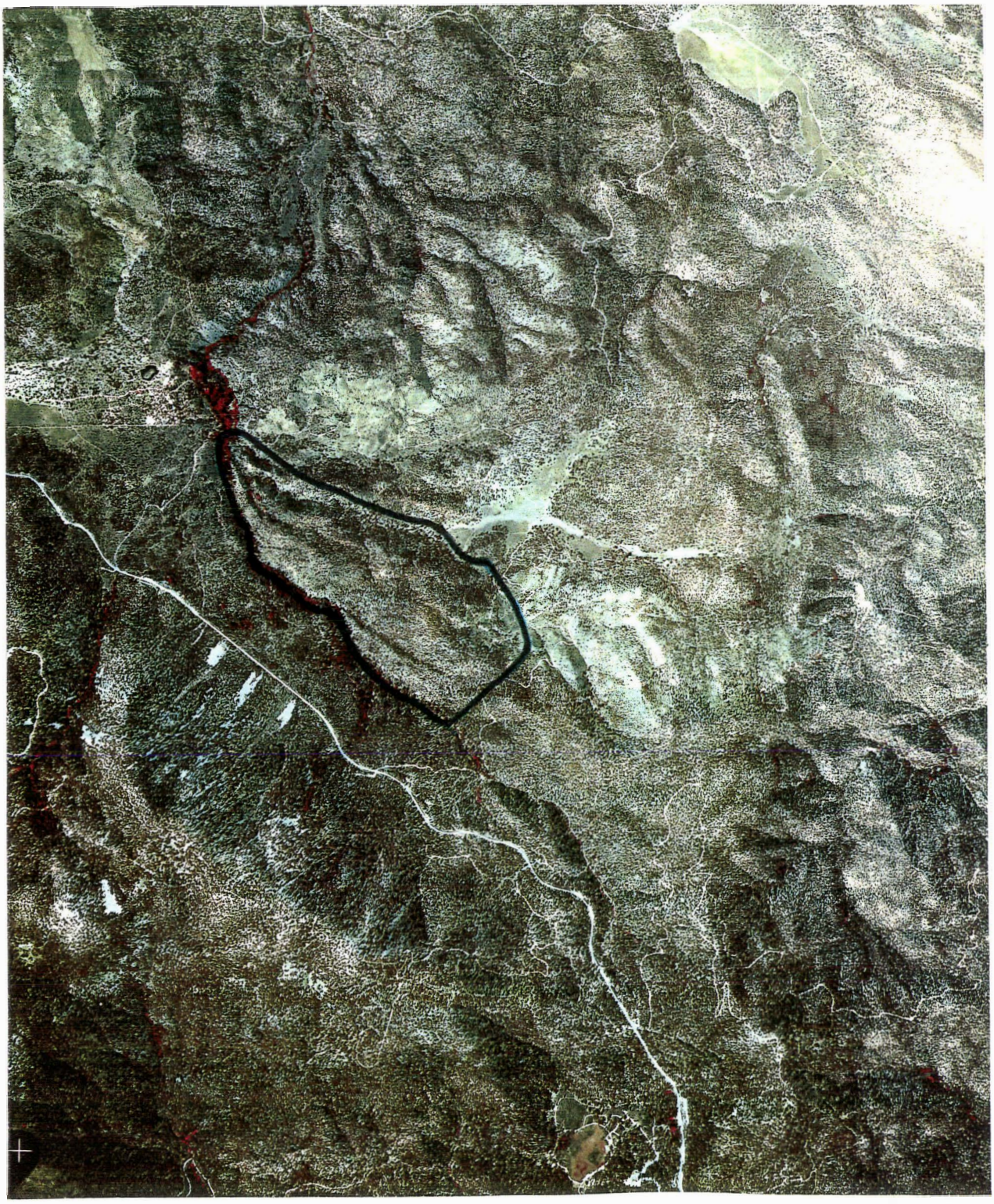
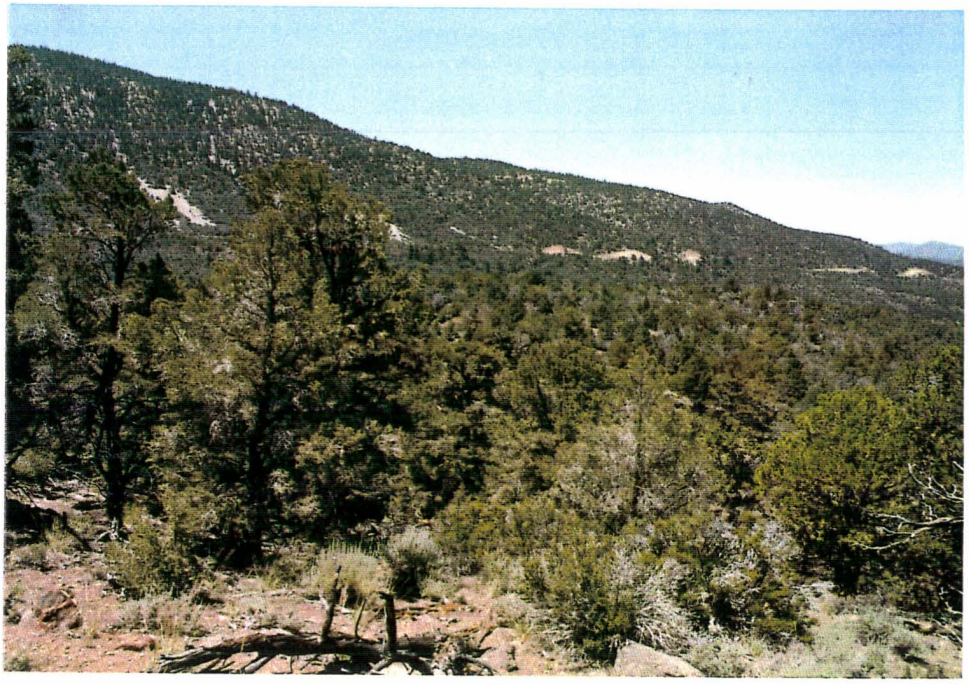
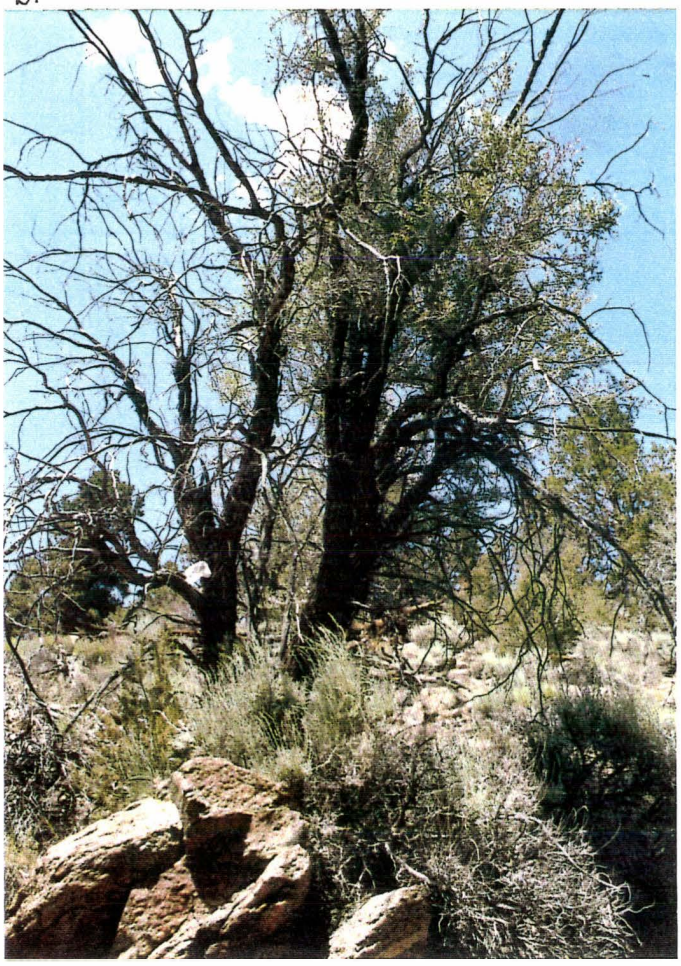


PLATE 3. BROOM FLAT RIDGE. Infrared Aerial Photograph. 20 August 1989. Soil Conservation Service NAPP 1839-121.

a.



b.



c.

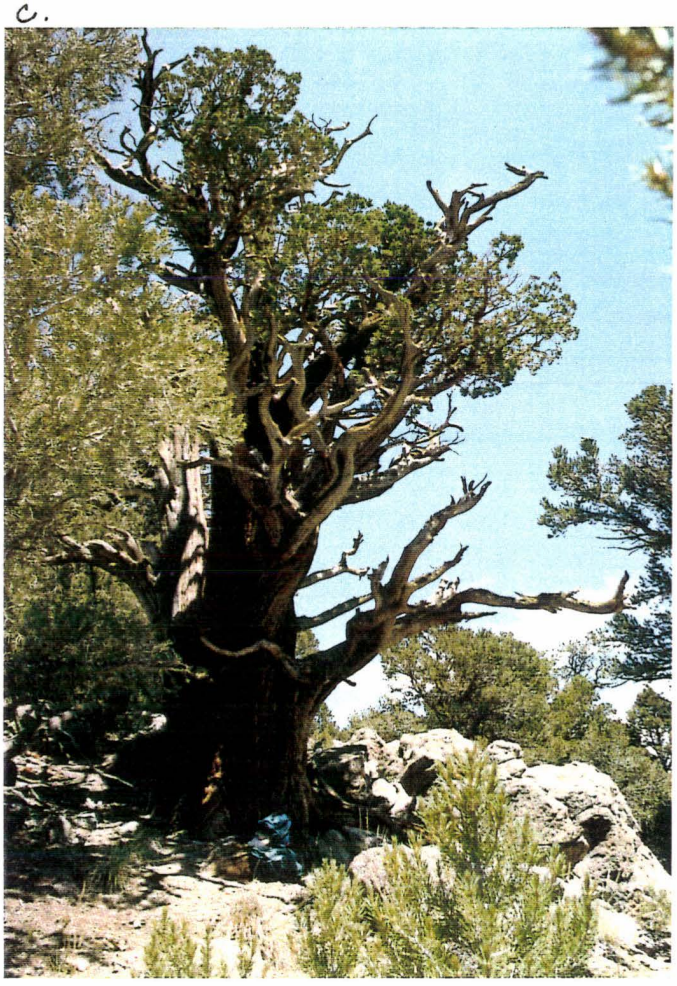


PLATE 4. Broom Flat Ridge Pinyon-Juniper Woodland

PLATE 4. Broom Flat Ridge Pinyon-Juniper Woodland

a. General photo of Broom Flat Ridge Pinyon-Juniper-Curlleaf Mountain Mohagany woodland in foreground. Taken from Forest Service Road 2N01, near the section number "36" on Onyx Peak 7.5' topographic map. Note roadcut of Highway 38 on ridge of eastern slope of Sugarloaf Mountain (background).

b. In this pinyon-juniper woodland, *Cercocarpus ledifolius* is an important co-dominant and can reach tremendous sizes. This individual had three main trunks with dbh's of 26", 29", and 33" (66, 74, and 84 cm).

c. Massive individuals of mountain juniper, *Juniperus occidentalis* var. *australis*, some with trunk diameters over six feet (nearly 2 m), occur on Broom Flat Ridge and on nearby Onyx Summit. These may be the oldest trees in southern California.

PLATE 5. Broom Flat Ridge Pinyon-Juniper Woodland

PLATE 5. Broom Flat Ridge Pinyon-Juniper Woodland

Understory associates vary throughout Broom Flat Ridge. These three photographs illustrate how species dominance and frequency vary with slope and exposure.

a. On the steepest south-facing slopes, *Artemisia tridentata* is a common shrubby associate, along with the grass *Poa fendleriana*.

b. In some possibly more xeric sites, tree cover decreases and *Chrysothamnus* and *Artemisia* co-dominate with a variety of perennial grasses.

c. This nearly level pinyon-juniper site has an understory of a scattered perennial bunchgrass, *Stipa cornuta*.

a.

PLATE 6.
Broom Flat Ridge
Great Basin Mixed Scrub
and Montane Manzanita Scrub

b.

c.

PLATE 6. Broom Flat Ridge Great Basin Mixed Scrub and Montane Manzanita Scrub

a. Great Basin Mixed Scrub occurs in a mosaic with the pinyon-juniper woodland at Broom Flat Ridge. Both as an understory for the woodland and as a separate plant community, it is a widespread vegetation type in this area.

b. On the eastern flanks of Broom Flat Ridge, as well as in other areas within the proposed boundaries of the RNA, Great Basin Mixed Scrub occurs without a pinyon-juniper overstory. The deep green shrubs in the photo are *Arctostaphylos patula*.

c. On the top of the ridge, an interesting stand of *Arctostaphylos patula*, a possible remnant of a fire, occurs here near the limit of its range in the midst of the pinyon-juniper woodland.

a.

PLATE 7.
Broom Flat Ridge
Jeffrey Pine Forest

b.

c.

PLATE 7. Broom Flat Ridge Jeffrey Pine Forest

a. A tall open jeffrey pine forest occurs along both the eastern and western margins of the site, as well as in cold air drainages along the ridgetop. This photo shows the *Pinus jeffreyi* forest in the foreground, with *Cercocarpus ledifolius* as an important associate. The higher, drier slopes in the background are covered with a typical Broom Flat pinyon-juniper woodland.

b. Mesic sites in the jeffrey pine forest are dominated by a meadowy association of *Smilacina stellata, Solidago californica,* and other tender herbaceous plants.

c. Thickets of *Rosa californica* and *Cercocarpus ledifolius* often occur where the jeffrey pine forest intergrades with the pinyon-juniper woodland.

a.

b.

PLATE 8. Broom Flat Ridge Jeffrey Pine Forest

PLATE 8. Broom Flat Ridge Jeffrey Pine Forest

a. Large specimens of *Pinus jeffreyi* occurs in gently sloping basins along the Broom Flat ridgetop. Here, the shrubby associate is *Cercocarpus ledifolius* and the grassy associate, *Oryzopsis hymenoides*.

b. *Opuntia basilaris* var. *basilaris* is a striking and colorful associate of both the jeffrey pine forest and the pinyon-juniper woodland at Broom Flat Ridge.

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